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ABSTRACT

This survey was undertaken by the Peace Corps to assist Senegal in identifying energy needs in rural areas and in implementing alternative, renewable energy projects at the community level. This book describes the sample, energy use, energy needs, and resources. Fifteen villages of fewer than 5,000 people were selected for data collection. The sources and end-users of energy were found to be quite similar in all of the villages, while differences occur primarily in the availability and ease of access to energy sources. Easier access to firewood and reducing demands on human energy for drawing water and grinding grain were rated top priorities by villagers. This book suggests some village-level programing for energy assistance. Profiles of selected villages are appended. (YP)

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Rural Energy Survey And Profiles: Senegal

A Training Manual

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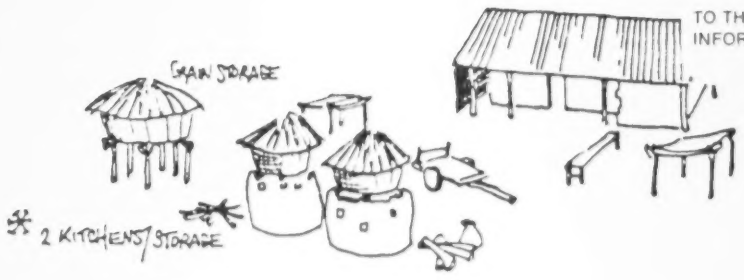

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RURAL ENERGY SURVEY

SENEGAL

Energy Sector
Office of Program Development
United States Peace Corps
Washington, D. C.

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EXECUTIVE SUMMARY

The Peace Corps Rural Energy Survey was developed as one component of a Renewable Energy Program undertaken by the Peace Corps in 1979 with the support of a 3-year grant from USAID. The purpose of the program is to assist developing countries in identifying energy needs in rural areas and in implementing alternative, renewable energy projects at the community level.

The survey is designed to obtain detailed information about energy use, energy needs and renewable energy resources in rural villages, and about the social, cultural and economic context of energy use in these communities. The survey design was field-tested in four countries; data was collected over the period of one year by Peace Corps Volunteers, villagers and/or development workers living and working in the local area. Survey teams used interviews, observation, and fuel measurements to gather data.

The Senegal Survey Project began in 1979, under sponsorship of Peace Corps/Senegal and the Ministries of Promotion Humaine and Research Scientific of the Government of Senegal. Data collection was carried out by Peace Corps Volunteers and local counterparts between December, 1979, and January, 1981, in 15 villages of less than 5,000 people, located in six administrative/geographic regions of the country. In addition to village-wide information, specific household data including fuel consumption figures was collected from 137 households, between eight and eleven in each village studied.

The sources and end-uses of energy (fuels, human and animal energy) were found to be quite similar in all of the villages studied, while differences occur primarily in the availability and ease of access to energy sources.

Easier access to firewood (less distant, less expensive) and reducing demands on human energy for drawing water and grinding grain were needs most often cited as priorities by villagers in every community, but the degree of urgency expressed varies considerably. In general, villages in the southern and eastern regions felt grain-grinding to be their most immediate problem, while in central and northern villages shortages of wood and water cause greatest concern.

The scope and detail of survey data about village life illustrates the interdependence of villagers' energy practices with their livelihood and their physical environment. The implications of this information for programming renewable energy technology projects are clear; the most effective projects will be those which address not only immediate energy needs but also related conditions (lack of water, deforestation, poor crop yields, etc.) which both contribute to and are worsened by present energy practices.

The methodology of the survey project proved successful in creating/enhancing an awareness and concern about energy issues in the villages participating. It is recommended that a similar village-level progam be implemented to demonstrate and disseminate appropriate renewable energy technologies which address the identified needs. Small RET extension centers located in a few of the survey villages can pursue an integrated development strategy, eventually introducing a range of technologies and providing training in their construction, operation and maintenance.

ACKNOWLEDGEMENTS

This report was prepared by the Energy Sector, Office of Program Development, U.S. Peace Corps, Washington, D. C., from narrative and numerical data submitted by survey teams in fifteen Senegalese villages. Processing of numerical data was performed by the International Science and Technology Institute, Inc., under Action/Peace Corps Contract No. 81-043-1022. The text, tables and graphs were prepared by Patricia Riley, Survey Coordinator, and Prudence Merton, Administrative Assistant, with the assistance of Paul Jankura, Energy Specialist, and Ada Jo Mann, Associate Energy Specialist.

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Peter Gallagher	Ndieye Sefour
Helen Desrosiers	Bokhol
Andrew Hailand	Mbaye Faye Mamadi
Mike Kidd	Manecounda
Allan Jelich	Ouarrack
Andy Thatcher	Ndoga Babacar
Danny Cunningham	Ngueth
Valerie Stetson	Loul Sessene
Jane Schlendorf	Loro
Alan Berroud	Ndankh Sene
Alfred Schulz	Bakadadji
Beverly Henning	Nguith
Richard Mead	Thiolom Fall
Janis Timberlake	Maniora

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Tomas Hobbs	1981

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I. INTRODUCTION

The Peace Corps Rural Energy Survey was developed as one component of a renewable energy program undertaken by the Peace Corps in 1979 with the support of a three-year grant from USAID. The purpose of the Peace Corps Energy Program is to assist developing countries in identifying energy needs in rural areas and in implementing alternative, renewable energy projects at the community level.

At the time that the study started there was little data available on energy use in rural areas. It was felt that the Peace Corps could be instrumental in developing a survey instrument and methodology for gathering energy data in rural villages. By field testing the survey in selected countries the project would produce actual village data on energy use, needs and resources.

The rural energy survey was designed to obtain information which is basic to the energy planning process. However, it was recognized that the survey project in Senegal could be only a field-test of the survey design, rather than a comprehensive national survey. The number of villages included in the study, and their selection based on criteria such as the presence of a Peace Corps Volunteer, limited the use of the survey as a nationwide energy assessment. The purpose of this effort was to provide as detailed a profile as possible of the village energy patterns and situations, in the expectation that these profiles will prove useful in devising plans for energy assistance to those villages, and have broader implications for other villages as well.

A. RURAL ENERGY SURVEY PROJECT GOALS AND OBJECTIVES

1. To design, test and revise a survey instrument which will furnish data at the village level regarding current energy uses, needs, and resources, and about the economic, social and cultural context of energy use in the community.

   a) The questionnaire should be comprehensive in scope, specific and detailed; and

   b) it should be adaptable to use in any rural community.

2. To design, test and revise a methodology, and a training program in that methodology, whereby the survey can be conducted by Peace Corps Volunteers, host country development workers, rural villagers or other interested parties who may be unfamiliar with surveys.

   a) The methodology should include active participation by members of the communities being surveyed; and

   b) the training design should provide bi- or multilingual models.

3. To collect and analyze detailed, valid information from selected villages in various countries:

   a) as a field test of the survey instrument, methodology and training program;

   b) to provide host country and Peace Corps energy planners and programmers with a better idea of energy needs at a village level; and

   c) to provide baseline information on the "before" energy conditions of a village, to help determine the effectiveness of introducing a new technology to meet perceived energy needs.

4. To create an awareness of energy uses and needs, and an interest and participation in energy planning and conservation, on the part of Peace Corps Volunteers, host country development workers, and the people of the villages taking part in the survey. This goal should be accomplished by:

   a) encouraging active participation in and discussion of the survey project by members of households in the

survey sample, by village leaders, by local development workers such as teachers, extension agents, and health and sanitation workers, and by local government officials;

b) providing training and technical information about renewable energy technology options, where possible; and

c) encouraging the understanding of the village as a system wherein the sum of individual actions and practices relating to energy can and do have significant impact on the prosperity of the village and each member within it.

B. DESCRIPTION OF THE SURVEY INSTRUMENT AND METHODOLOGY

The Peace Corps Rural Energy Survey was from its inception regarded as an experiment in energy assessment. The challenge was to design a survey which would be comprehensive enough to yield accurate and useful data on rural energy regimes; simple and clear enough to be understood and administered by people with minimal survey and technical training; and yet sensitive enough to socio-cultural, economic and political factors to allow PCVs and their counterparts to carry out the survey project without jeopardizing their other roles in the community. Moreover, it was of paramount importance to develop a participatory survey design in order to promote increased awareness within the surveyed villages about energy, and enlist the cooperation and involvement of host country sponsoring agencies, local development workers and community leaders.

Bearing in mind the above requirements, a survey instrument and methodology were developed for field testing. The complete survey instrument is appended to this report. The survey design is briefly described below.

Instrument

The survey instrument is designed to gather two kinds of information; 1) a description of the existing energy regime in a rural village; and 2) an evaluation of the potential for developing local renewable energy resources. The questionnaire addresses a wide range of practices and situations in the village, in individual households and small food shops, and in farming activities, which revolve around energy uses and energy needs of the village.

The questionnaire is divided into five sections, four of which contain both "computable" and "narrative" subsections. These designations refer to the type of answer required:

- Computable - yes, no, or numerical answers to be entered in boxes on the questionnaire
- Narrative - descriptions, sketches or written explanations in answer to open-ended questions, with room for considerable detail

In addition, the sections of the questionnaire concerning individual households and small food shops contain a fuel measurement subsection on which actual fuel use is recorded over a year-long period. The five sections are:

1. The Village - general information about the characteristics of the village and the surrounding area.

2. Domestic Energy Use - household characteristics, identification and measurement of fuel use by function.

3. Small Food Shop Energy Use - type of business, identification and measurement of fuel use by function. (This section was not found applicable to villages in the Senegal project.)

4. Agricultural Energy Use - general agricultural practices in the area and specific activities of selected farmers.

5. Renewable Energy - identification of renewable energy resources in the area of the village, information about current uses of those resources, and measurements/analyses of the potential of the resources where possible.

Methodology

For purposes of the field-tests, no specific methodology was used to derive a representative sample of villages within a country, as the survey sites were determined by the availability of appropriate enumerators. Peace Corps and host country sponsors were encouraged to try, in as much as was possible, to find sites in a variety of geographic and economic areas. It was recognized, however, that the data collected could not be considered statistically valid for the entire country.

The survey is designed as a longitudinal study, in which information is to be gathered over an entire year in order to examine seasonal changes in the patterns of energy use, fuel availability and renewable resources (sun, wind, water, etc.).

The most important features of the methodology developed for conducting the rural energy survey are: 1) the enumerators are local residents, trained to work as teams; and 2) the data is collected in a number of ways, including observation, interviews and fuel measurement, to produce a combined quantitative and descriptive profile of the energy use pattern of a village over a twelve month period.

C. THE SURVEY PROJECT IN SENEGAL

Sponsorship Agreement

The survey project in Senegal was sponsored jointly by the Peace Corps and two ministries of the Government of Senegal, the Ministry of Promotion Humaine and the Ministry of Research Scientific. This sponsorship agreement was made in July of 1979, and the task of identifying villages and enumerator teams began.

Training Workshop

Under the auspices of the sponsoring organizations, a five-day survey training workshop was held in MBour, Senegal from November 25-30, 1979. There were 54 participants in the workshop, 28 Senegalese and 26 Peace Corps Volunteers representing 26 potential survey sites. Each of the Senegalese counterparts actually lived in the villages selected; while not all of the PCVs attending had been in Senegal for eight months, as originally specified by the survey project designers, all had been living in their village sites for at least four months.

The wide variety of backgrounds and experience among those attending and particularly of education, literacy and language facility, occasioned an impressive effort on the part of the training staff to accomodate all partipants while imparting a great deal of detailed information. The workshop was conducted primarily in English and French, with some sessions held in Mandinka and Wolof. In the expressed opinions of both trainers and participants, the training process was extremely successful, not only in transferring information and allowing practice in using the survey instrument, but also in teambuilding between the American and Senegalese enumerators for each site. A detailed report on the training workshop, as well as a survey training manual developed over the course of all five workshops in the survey project, are available from the Office of Program Development, Energy Sector, U.S. Peace Corps.

Data Collection

Upon returning to their villages, the survey teams began introducing the project to the community. Community meetings were held, and in some cases the Regional Inspectors from Promotion Humaine visited villages to endorse the energy survey.

Most survey teams began interviews and fuel measurements as soon as they had selected and recruited their random sample of households. The survey periods represented in the completed reports range from December 15, 1979 - December 15, 1980 to February 25, 1980 - February 25, 1981.

Attrition

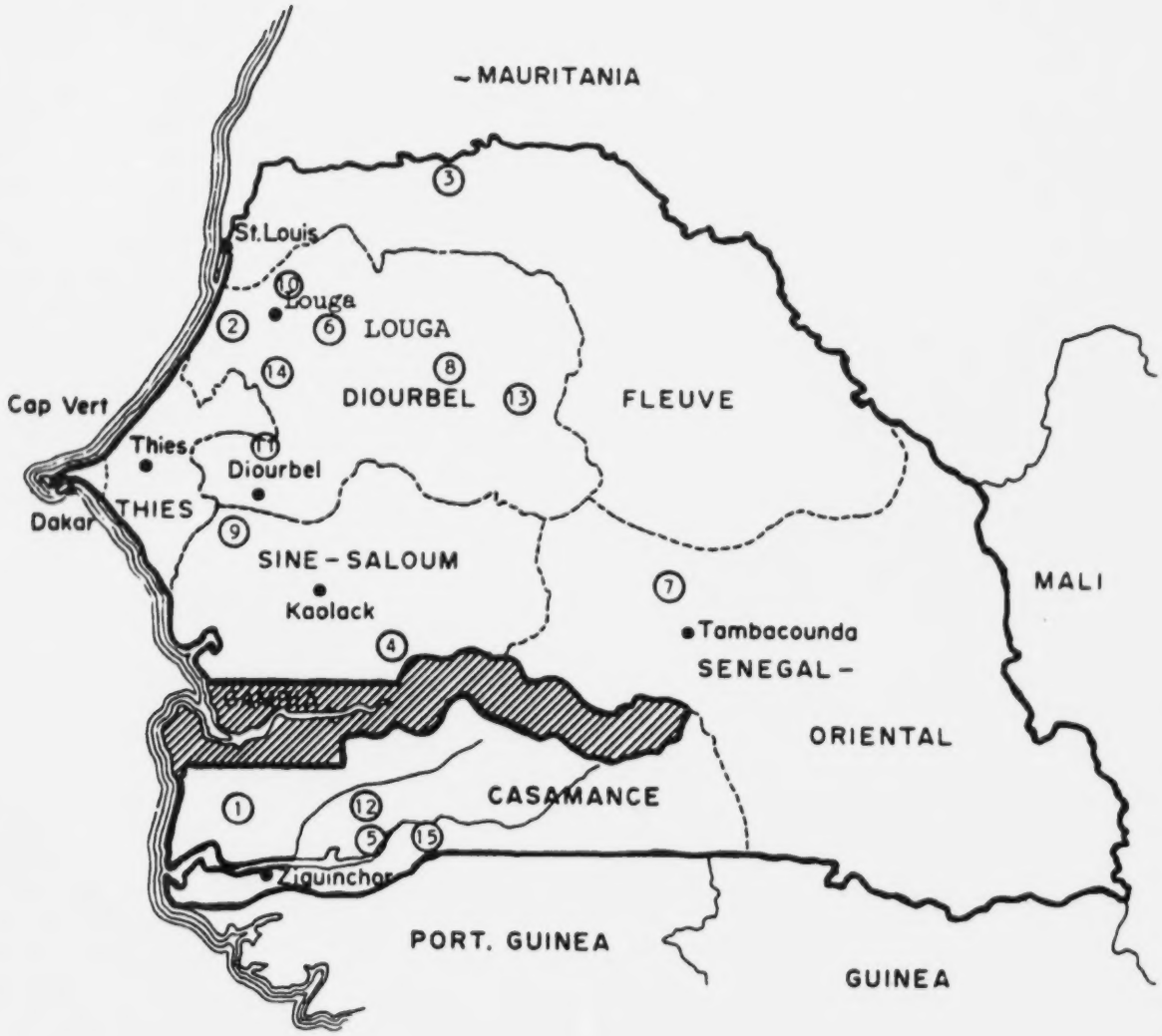
Considerable attrition of the original 26 survey teams occurred throughout 1980. Reasons for dropping the survey were usually either transfers of one or both team members or the fact that the survey enumerators lacked the time to continue the project as a secondary activity. While the Survey Coordinator, a PCV posted in Dakar, continued to write to or visit the survey sites as often as possible in an effort to enourage completion of more reports, the extent of time and effort required by the project proved too great for some of the volunteer enumerator teams.

Completed Reports

Ultimately, fifteen survey teams completed their first quarter reports, which were received in Washington between June and September 1980. Of these fifteen village survey teams, eleven completed the entire year's study, and two more completed two and three quarters respectively, (fuel measurments for the last three quarters of one village were not received with the questionnaire).

Analysis

Analysis of the survey data is presented in this report in several forms, including descriptive summaries, numerical tables and narrative profiles of each village. The implications of the data (and the survey methodology) for programming appropriate technology projects is discussed in some detail. Various renewable energy technologies which address the priority energy-related problems identified by villagers are noted, both by village and in general. Finally, a recommendation is presented for building on the survey project experience through the implementation of Renewable Energy Technology extension centers in some of the villages studied.



VILLAGES PARTICIPATING IN THE SENEGAL ENERGY SURVEY

1 - Kaynobon
2 - Ndieye Sefour
3 - Bokhol
4 - Mbaye Faye Mamadi
5 - Manecounda
6 - Ouarrack
7 - Ndoga Babacar
8 - Ngueth
9 - Loul Sessene
10 - Loro
11 - Ndankh Sene
12 - Bakadadji
13 - Nguith
14 - Thiolom Fall
15 - Maniora

II. SURVEY RESULTS

A. SAMPLE

VILLAGE CHARACTERISTICS

Location and Size

The fifteen villages studied in the Rural Energy Survey Project in Senegal are located throughout the country, from Bokhol, on the Senegal River, to Bakadadji in the Southern Casamance. Six administrative regions of the country are represented, with the distribution as follows:

Table 1

PARTICIPATING VILLAGES

Region	Villages	Population
Fleuve	Bokhol	1000-5000
Diourbel	Ndankh Sene	1000-5000
Louga	Ngueth	100-500
	Nguith	1000-5000
	Ndieye Sefour	500-1000
	Thiolom Fall	500-1000
	Ouarrack	1000-5000
	Loro	1000-5000
Sine Saloum	Loul Sessene	1000-5000
	Mbaye Faye Mamadi	500-1000
Casamance	Kagnobon	1000-5000
	Maniora	100-500
	Manecounda	100-500
	Bakadadji	500-1000
Senegal Oriental	Ndoga Babacar	100-500

Transportation

Most of the transportation available to villagers in the survey sites is non-motorized. Only one village, Kagnobon, is served by buses, which pass through a few times per week. Four villages

report having taxis, and/or small trucks which carry passengers, based in the community and available to transport villagers. Ouarrack residents can take the train to their departmental capital, Louga, 22 kilometers away, as the village is next to the railroad line. Also, there are a few residents in seven of the villages who own mopeds or motorcycles, but never more than 2% of the population. The only other motor transport used by villagers consists of occasional vehicles passing through and willing to take passengers.

For most local transportation, the survey population relies on carts drawn by horses or oxen to carry goods and people to and from the village. Individuals either walk or ride horses and donkeys. Bicycles are rare; except for Kagnobon, where 30% of the households have one, and Maniora where 25% of the families own them, fewer than 1% of the villagers have bicycles.

Major Occupation - Agriculture

Farming is the primary occupation in all of the villages studied, although in two of the river-side villages in Casamance Region, fishing also provides a major source of income.

Cash Crops: In all but one of the fifteen communities in the survey project, the farmers are engaged in raising peanuts as a cash crop. During the survey period, 1979-1980, the Government of Senegal's "Office National de Cooperation et d'Assistance au Development" (ONCAD) (National Office for Cooperation and Development Assistance) was the official purchasing agency for peanuts, and farmers sold their peanut crops to ONCAD for approximately 43 CFA francs per kilogram. Most of the villages surveyed had an ONCAD warehouse either in or very near the village. These centers not only buy the harvested peanut crops but are also the suppliers of seed peanuts, fertilizers and (occasionally) machinery for the peanut farmers. The usual arrangement has been for a farmer to obtain seed and fertilizer before the advent of the rains in June or July, and then to pay for the supplies, with interest, from the proceeds of the sale of his crop in November or December.

In the one village surveyed where peanuts are not grown, the Government of Senegal has introduced a project promoting the production of tomatoes. The project makes use of irrigation, and the tomatoes are processed in a cannery near the village.

Other Crops: Next to peanuts, millet is the most widely grown crop in the villages surveyed, a fact which is hardly surprising as it is also reported as the staple food in most communities, being eaten two or even three times a day. Millet is grown in 14 of the 15 villages in the study, primarily for consumption by the farmers' families, with surplus crops sold either to ONCAD or in local markets.

Table 2

VILLAGE CHARACTERISTICS - I

	Number of Villages	Percent of Total
Population		
100-499	4	26.6
500-999	4	26.6
1000-4999	7	46.8
over 5000	0	0
Total	15	100.0
Average Distance to Nearest Village:		
1.5 kilometers		
Average Distance to Regional Capital:		
86.5 kilometers		
Transportation		
Villages with		
Bus service	1	6.7
Train Service	1	6.7
Taxis (village based) average per village: 2	3	20.0
Trucks (village based) average per village: 1	3	20.0
Bicycles average % of population owning bicycles: 9%	7	46.7
Motorcycles/mopeds average % of population owning motorcycles or mopeds: 1%	7	46.7
Predominant Occupations		
Farming	13	86.7
Fishing	0	0
Farming and Fishing	2	13.3
Total	15	100.0

Rice is cultivated by villagers in the four Casamance sites, one village in Sine Saloum, and in Bokhol, on the Senegal River, where water is more readily available than in other regions of Senegal. (In these villages, the households participating in the survey usually eat rice instead of millet at least once a day.) Other crops reported by the survey teams as widely planted are beans (especially in Louga Region) corn, yams and melons. Two of the Casamance villages cultivate citrus and mangoes, and some farmers grow cotton in N'doga Babacar, near Tambacounda in Senegal Oriental.

Livestock: In all of the villages studied, at least some of the residents keep animals, for transportation, work, food or income production. Horses, donkeys and oxen represent the major means of local transportation and are used by many farmers in preparing their fields for cultivation and for drawing seeders, the planting machines used widely for both peanut and millet farming in the surveyed villages.

In six of the villages in the sample, "elevage" or animal-raising is a major income producing occupation. As the survey teams did not collect specific quantified information about income or ownership of land or animals, it is not possible to delineate the exact proportion of crop farming and livestock farming in these communities; however, elevage would appear to be an important component of the agriculture practiced in Senegal, particularly in the central regions. One of the major advantages of livestock raising in conjunction with crop farming in this fragile environment is that the cattle, sheep and goats are less affected (in the short term) by uncertain and irregular rains than are the crops. Thus, many households interviewed by survey teams in the early months of 1980 reported that the sale of livestock provided their major or only source of income in the wake of an extremely poor 1979 harvest. Another, perhaps even more important, advantage of livestock raising to the livelihood of Senegalese villagers is its integration with the crop cycle; animals can be fed on the peanut hay remaining after threshing and selling the peanut crop, and their dung is collected and spread over the fields before the next planting season, replacing at least some part of the nutrients lost from the soil through overplanting and wind erosion. Furthermore, the presence of livestock is important in that in some areas, the dung is used as a cooking fuel.

The villages in the Sine Saloum and Louga Regions often include in their populations members of the Peuhl or Fulani tribe, traditionally nomadic herdsmen. The Peuhls generally tend their herds of cattle on the outskirts of the village, and in some cases they care for other villagers' cattle as well, for compensation of various kinds. In several villages the survey teams found that the Peuhl households regularly collected and burned dung in their cooking fires, while the other villagers did not. In the villages with the greatest scarcity of firewood and agricultural residues

available for cooking fuel, however, other ethnic groups were also observed burning dung, although it was clearly not the preferred fuel.

The Peuhl herders often leave the farming villages when the rains arrive, taking the cattle north or east to non-cultivated lands which offer grazing during that period. This migration, coming at the same time as the clearing of the fields for farming and the increasing dampness of remaining firewood sources, makes the rainy season the most precarious for Senegalese villagers in their daily struggle to find fuel.

Other Occupations

Skilled Labor: The villages in the study are small and almost exclusively oriented toward agriculture. The majority of skilled tradesmen in the communities are engaged in making housing, clothing and tools. Twelve of the fifteen villages have tailors, ten have masons and nine, blacksmiths. Five villages have mechanics, five have potters and four, carpenters. Five survey sites report the presence of other skilled workers such as "charette" or horse-cart repairmen, makers of simple jewelry, a watchmaker, a shoemaker, a radio repairman and a leather worker.

Table 3

SKILLED LABOR

Number of villages w/ skilled workers in the following trades:	Number of Skilled Workers Per Village										
	0	1	2	3	4	5	6	7	8	9	10
Mechanics	10	1	3	1							
Masons	5	0	3	2	1	1	3				
Carpenters	11	0	2	1	1						
Potters	10	3						1	1		
Weavers	12	2	1								
Tailors	3	2	4	2	1	1	1				1
Blacksmiths	6	5	2	1	1						
Other	10	3	1	1							

Seasonal Labor: In most of the villages studied, the agricultural season is completely dependent on the annual rains. Virtually no farming can be done until the rains arrive in June or July. Crops are planted immediately after the first rain, and are generally harvested and stored or sold by November-December.

During the first half of the calendar year, many men leave the village to find work in the cities or larger towns, or in some cases in neighboring countries. Often, the households interviewed by the energy survey teams received most of their income during the January to June period from relatives in the cities. Interviewers were told that most of the men work as vendors of cloth or other goods, carpenters and furniture makers, or servants. In a few villages, predominantly those in the Casamance region, family members make brooms and bamboo mats to take to the cities to sell.

Just as there is an exodus from the farming villages in the winter and spring months, there is an influx of workers to many communities at the start of the rainy season. Laborers from other areas hire out to those farmers who can pay them as field hands. The laborers are usually provided with meals by the farmers' family, in addition to daily wages reported as usually around 200-250 CFA per day. In some instances they are also given lodging, as in Ndoya Babacar, in the fairly remote eastern region of the country, where surveyors found that every compound in the survey sample contained houses for the migrant workers.

Table 4

VILLAGE CHARACTERISTICS - II

	Number of villages	Percent of Total
Schools		
Koranic schools only	4	26.7
Primary schools	9	60.0
Primary and secondary schools	2	13.3
Public Services		
Post office	0	0
Telegraph	0	0
Agricultural extension agent	6	40.0
Health clinics	8	53.3
Cooperatives		
no coops	1	6.7
1 coop	10	66.6
2 coops	2	13.3
3 coops	1	6.7
4 coops	1	6.7

Services, Schools, Cooperatives

While all of the villages in the study are too small to have post office or telegraph services, eleven of the fifteen have educational facilities, including two with secondary schools. Most villages, including those without government primary schools, have at least one Koranic school, meeting in a community-built center or in the compound of a Marabout who instructs the young boys of the village in the Koran and the teachings of Islam. Eight villages have health clinics, and many of those without clinics have organized community-sponsored maternity centers, dispensaries or pharmacies for simple health care. Six villages have an agricultural extension agent residing and working in the village.

All but one of the villages has at least one cooperative organization, an ONCAD peanut cooperative center for the farmers in the area. Most of the communities also have "associations," either by sex or age groups or along tribal lines, which conduct special projects such as operating credit unions, farming cooperative gardens or peanut fields, or making clothes and crafts to sell. One village has a center for another government cooperative, Bendez.

Markets and Food Shops

Only two of the villages in the survey hold regular food markets: Bokhol, which has two daily markets, and N'doga Babacar, in which a new weekly market has been established. Neither village is a major market center for its area. All but one of the communities have small shops which sell staples (sugar, rice, dried fish, tea, etc.) and kerosene. Villagers also buy food and other goods from travelling vendors and, in some cases, from each other, or they go to nearby market towns.

There were no reports of food establishments for selling prepared food, snacks or meals, with the exception of bakeries in the two market towns mentioned above. The lack of street corner stands, restaurants, teashops or bars, however, does not mean that all such commodities are unavailable; a number of households in the survey sample occasionally sell palm wine, kola nuts, millet beer, oranges, roasted peanuts, etc., to supplement their income from farming. (The survey teams did not attempt to separate fuel use for such activities as brewing beer or roasting peanuts from the overall domestic fuel consumption. The issue arose rarely, and there was no indication of extraordinary measures taken for obtaining or using fuel for these purposes any more than for feasting neighbors and friends at a marriage or baptism.)

HOUSEHOLD CHARACTERISTICS

The focus of the rural energy survey is villagers' use of energy in their domestic lives and in their agricultural work. One hundred and thirty-seven households in fifteen villages comprise the Senegal Survey sample. The households were selected at random from the entire village population following procedures outlined in the attached survey workbook. Each survey team selected 8 to 11 households.

Within the sample, household size ranges from two persons to forty-one. Approximately sixty percent of the households number between six and twelve people. Over half of the families had at least one child in school during 1980, although only eight percent of the household heads reported having had any schooling at all.

Almost all of the households surveyed derive their primary income from farming; only seven of one hundred and thirty-seven families report employment as their major source of income, and four families say most of their income comes from their own businesses. Due to the short agricultural season in Senegal, however, slightly more than half of the households do have other income sources, whether sale of livestock, fish or other goods, seasonal work or money sent by family members working in the cities.

Table 5

HOUSEHOLDS IN THE SURVEY SAMPLE

	Number of Households surveyed	percent per village of total	quarters reported 1 2 3 4
Kagnobon	10	7.3	x x x x *
Ndieye Sefour	8	5.8	x x x x
Boknol	8	5.8	x x x x
Mbaye Faye Mamadi	10	7.3	x x x x
Manecounda	10	7.3	x x x
Ouarrack	8	5.8	x x x x
Ndoga Babacar	10	7.3	x
Ngueth	8	5.8	x x x
Loul Sessene	10	7.3	x
Loro	8	5.8	x x x x
Ndankh Sene	11	8.0	x x x x
Bakadadji	10	7.3	x x x x
Nguith	8	5.8	x x x x
Thiolom Fall	8	5.8	x x x x
Maniora	10	7.3	x x x x

* Fuel measurements not received for quarters 2,3, & 4.

Table 6

HOUSEHOLD CHARACTERISTICS

Average household size	10.3
Average years of schooling - household head	.5
Average number of children in school	1.1
Primary income source (% of households)	
agriculture	91.9
own business	2.9
employment	5.1
Percent of households with secondary source of income	51.8

Some of the households in the survey sample consist of nuclear families, i.e., one father, one mother, and their children. Many more are extended families; often a household head has several wives, each with children, and it is quite common for the household to include grandparents, aunts and uncles, brothers and cousins of the household head and their wives and children. For purposes of the survey, such extended families are considered one household if they share food and fuel; it is a common practice in many village compounds for the women to alternate responsibilities for firewood collection and food preparation, each cooking for the entire group for a few days at a time. If meals are cooked separately for each man and his own wives and children, however, this smaller group is identified as the household.

Living arrangements also vary among households in the sample. The majority live in compounds, or "concessions," containing several buildings and surrounded at least partially by fences of millet stalks, thorn bushes, bamboo, or occasionally, mudbricks or sheets of tin. Some compounds are quite large and house more than one extended family group, while others are smaller areas attached or connected to a family "cluster" of compounds.

Further descriptions of the households in the survey sample, and their houses, facilities and implements can be found in the Village Profiles appended to this report.

B. ENERGY USE

ENERGY FROM FUELS

Through a combination of interviews, observation and measurement, information was collected about domestic fuel use in cooking, heating water, space heating, lighting and grain grinding, as well as farming practices which might involve fuel use. End uses for measured fuels were limited to cooking, lighting and "other." In some cases the narrative portion of a survey report provides extra detail about fuel use patterns (for example, the use of a few drops of kerosene to start cooking fires in rainy weather, or dampening of millet stalks to make them burn more slowly) not reflected on fuel measurement records.

Table 7

THE PATTERN OF DOMESTIC FUEL USE BY FUNCTION
(Percent of households using fuel)
n = 137

	Cooking	Heating water	Lighting	Space Heating
Wood	98.5	58.4	21.2	32.8
Charcoal	38.7	27.0	0.7	21.9
Dung	21.9	16.1	1.5	0.7
Agricultural Residue	40.1	24.1	2.9	5.1
Kerosene	0	0	99.3	0
Propane	0	0	0	0
Electricity	0	0	0	0
Candles	0	0	27.0	0
Other	0	1.5	17.5	0

Traditional Fuels Used

Firewood is the most widely used fuel in every village participating in the energy survey. It is the primary cooking fuel, used by 98.5% of all households in the survey sample; it is used by more than half of these households for heating water and by over 20% as a source of lighting.

Thirteen of the survey teams supplied at least partial lists of the tree varieties growing in the area of the village: eleven reports included notation of the species preferred for cooking, while the other two reports explained that all varieties available are used, with no strong preferences expressed by villagers. The following is a list of the trees most often mentioned as preferred cooking fuels by villagers in the regions indicated, (with Wolof names where available).

Table 8

PREFERRED TREES FOR USE AS FIREWOOD

F = Fleuve D = Diourbel L = Louga

SS = Sine Saloum C = Casamance SO = Senegal Oriental

	F	D	L	SS	C	SO
Acacia albida ("Kad")		x				
Acacia raddiana, ("Seng")	x		x			
Acacia Senegal ("Verek"), gum arabic			x			
Balanites aegyptiaca, ("Sump")	x		x			
Combretum glutinosum, ("Rat")			x	x		
Combretum micranthum, ("Kinkeliba")				x	x	
Combretum nigricana						x
Cordyla pinnata, ("Dimb")			x	x		
Grewia bicolor, ("Kel")	x		x			
Khaya Senegalensis ("Kaicedra" - Fr) African mahogany					x	
Mango				x	x	
Orange				x	x	
Prosopis africana, ("Ir"), ironwood	x		x	x	x	
Pterocarpus erinaceus, ("Ven") African rosewood					x	x

TREES LISTED LESS FREQUENTLY AS PREFERRED FOR USE AS FIREWOOD

	F	D	L	SS	C	SO
Acacia seyal ("Surur")		x	x			
Anogeissus leiocarpus				x		
Bombax costatum - kapok						x
Ceiba pentandra ("fromagier" - Fr) silk cotton					x	
Coco nucifera - coconut					x	
Elaeis Guinensi - oil palm					x	
Lannea acida				x		
Parkia biglobosa - parki						x
Ziziphus Mauritiana - ("Sedem") jujube	x			x		

Two villages in northern Louga region identified the most widely used fire fuel as Guiera Senegalensis ("Ngeer"), a scrub bush which grows quickly in fallow fields and grazing areas after the rains. In the Sahelian plain where few large trees remain in the vicinity of the village, it is often the small bushes which serve as the primary source of firewood for cooking, being both nearer and easier to transport than large tree limbs and trunks.

Some trees are rarely used for fuel. Adamsonia digitata, or baobab, grows in most areas of Senegal but is not used for firewood in most of the villages studied. Acacia albida ("Kad") is reported as the "most abundant tree" in Diourbel and several parts of Louga region, but except in Diourbel it is usually not burned, as it is considered more valuable as a "fertilizer," having several characteristics which help protect crops and enrich the soil for farming. Azadirachta indica, nime or neem trees, are present within most of the villages; highly prized as shade trees, nimes are planted, watered and carefully tended by many villagers who want shaded areas within their compounds for eating, resting and socializing, and for tethering horses and donkeys. In most villages studied, nime is rarely cut for firewood, although broken or dead branches may occasionally be burned. The two Sine Saloum villages in the survey, however, report that nime is a preferred firewood source.

Another tree variety recently introduced in about half of the villages in the survey is eucalyptus. Unfortunately, the first experiments with eucalyptus seedlings were unsuccessful in most of these communities, due primarily to the fact that the seedlings required daily watering and the time and effort required for this proved too much for the villagers. Where eucalyptus had been tended successfully during the survey year, villagers explained that they were growing the trees for their medicinal properties.

Trees used for heating fires are generally the same varieties as for cooking, and in fact heating of huts is often done with the coals from the cooking fire. Hardwood varieties are preferred for heating, as they burn longer and make more coals. Trunks and large branches of dead trees are often burned outside, in the center of a compound; one large log may provide an evening fire for several days or even weeks.

In areas of firewood scarcity brush and agricultural residue is used to stretch the wood supply. Forty percent of the households participating in the survey use agricultural residue for cooking, and a few use it also for heating. The kinds of agricultural waste most often used, according to the survey reports, are millet stalks, corn cobs, and occasionally, peanut hay, although the hay is more frequently fed to horses, donkeys and oxen.

In six of the fifteen villages studied, some of the residents burn animal dung in their cooking fires. In two of the villages it is only the Peuhl families in the community, traditional herders who tend their own cattle and those of other villagers, who use dung as a cooking fuel. In other areas some members of other tribes are using dung now, although they would not have considered it ten years ago and still express dislike for the fuel.

Charcoal is used for some cooking, but more often this fuel is employed for brewing tea or coffee, and for space heating. Over one third of the households in the survey sample mentioned the use of charcoal as a cooking fuel, and 27% report charcoal use for heating water. The narrative portions of the survey reports, however, indicate that these responses refer primarily to the process of making tea on small locally-made charcoal burners ("furneaux"), rather than the cooking of food. (Also, in a few cases respondents were speaking of cooking on the coals from their woodfires.) The charcoal furneaux are also used for heating the interiors of sleeping huts.

The nature and quality of the charcoal used varies widely. In eight villages studied, charcoal is offered for sale by residents of that or a neighboring village, while in the other seven sites most charcoal used is manufactured or found by the household members themselves (or brought by relatives or guests from the cities or nearby towns). The strict regulation instituted by the Government of Senegal on the production and sale of charcoal contributed to the difficulty experienced by many survey teams in obtaining valid data concerning the source of this fuel, as villagers were uncomfortable or unresponsive to questions perceived as threatening to their fuel supply (or livelihood). In some cases, villagers report that they search for and find charcoal "in the bush." In others, it is explained that the custom is to find large fallen trees, "set them on fire and watch over them," throwing sand or dirt on the fire when the desired degree of carbonization has taken place.

A large proportion of the charcoal used is not manufactured at all. As one report explains:

> "the wives in each compound...make the little charcoal that they use (generally used only for afternoon tea, which is not made every day) by cracking off the burning ends of the wood in the cooking fire or heating fire and then burying these coals in the sand near the fire. They do it each day as they cook or sit around the fire."

Table 9

FUEL AVAILABILITY

General availability of fuels in surveyed villages

	Always	Almost Always	Occasionally	Seldom	Never	no response
Firewood	10	2	2			1
Charcoal	6	5	2	1	1	
Dung	8	5	2			
Agricultural Residue	12	3				
Candles	9	3		1	1	1
Gasoline*	1	3	1	1	7	2
Kerosene	7	6	2			
Propane*	2	1	1	2	8	1
Diesel*		15				
Electricity					13	2

* Not sold in village, but available for sale in nearby towns.

Table 10

NUMBER OF VILLAGES WHERE RESIDENTS HAVE EXPRESSED CONCERN ABOUT AVAILABILITY OF FUEL

Firewood	11	Gasoline	2
Charcoal	6	Kerosene	8
Dung	2	Propane	4
Agricultural Residue	1	Diesel Fuel	8
Candles	1	Electricity	2

Commercial Fuels Used

Kerosene is the primary lighting fuel for almost every household in the survey sample. (Only one household, a small family in the village of Loul Sessene, reports no use of kerosene. They rely on firelight in the evenings, but say they wish they could afford to buy kerosene and hope to do so in the future.) Other fuels mentioned most often as being used for lighting are flashlight batteries, candles and firewood.

Gasoline, diesel fuel and propane are reportedly in use in a number of the villages studied. None of the sample households used any of these fuels during the survey year, so there was no actual measurement of amounts. Propane is used in a few villages for cooking and lighting, but is too expensive for most villagers to afford. Gasoline is used primarily for transportation (taxis, trucks, fishing boats, a few motorcycles and mopeds) and running generators. Diesel fuel use was reported most often for powering millet and rice grinders (8 of the 15 villagers have diesel-powered grinders) and pumps (Nguith's one well has a pump, and there are irrigation pumps in Bokhol). No reports mentioned any domestic use of gasoline or diesel fuel.

Table 11

FUEL USE AND SALE IN SURVEYED VILLAGES

	Used in Village		Sold in Village	
	Number	Percent	Number	Percent
Traditional Fuels:				
Firewood	15	100	8	53.3
Charcoal	15	100	8	53.3
Dung	6	40	0	0
Agricultural Residue	9	60	0	0
Candles	11	73.3	8	53.3
Other	2	13.3	0	0
Commercial Fuels:				
Gasoline	4	26.7	0	0
Kerosene	15	100.0	14	93.3
Propane	4	26.7	0	0
Diesel Fuel	4*	26.7	0	0
Other	0	0	0	0

* Number rose to 7 (46.8%) by the end of 1980, as 3 villages acquired diesel powered grain grinding machines. The fuel is still not sold in the villages.

Patterns of Fuel Use

The understanding of how fuels are used is as important to energy assessments as knowing which fuels are used. The village profiles summarize the information about fuel use patterns collected by each survey team, by village, as most of this data is in narrative form. The information includes how various fuels are obtained, and from what sources, who obtains them, the manner in which fuels are used, the purpose of their use and who uses them. When available, the data also includes seasonal or other adjustments or changes in the above, and the suitability of fuels to end-uses, advantages and disadvantages of each fuel and relative ease or difficulty in obtaining and using each fuel, in the perception of the villagers.

The following is a summary of the data on fuel use patterns for the survey population as a whole.

Obtaining Firewood: Firewood is the primary cooking fuel in all of the villages surveyed. The wood (including brush wood) used in each village comes from the local area, and although the

range of distance from village to the nearest wooded area is from less than 1 kilometer to 45 kilometers, thirteen of the fifteen villages have at least some available trees within a 5 kilometer radius. The distance between village and firewood source appears to be the major factor determining the fuel collecting practices of the households studied, although other factors such as available cash and transport facilities and family composition and size are also important.

Table 12

DISTANCE TRAVELED AND TIME SPENT TO COLLECT FUEL

Distance from village to nearest firewood source:	**0-1 km**	**1-5 km**	**5-10 km**	**10+ km**
Number of villages: (n = 15)	1	12	0	2

Time spent daily collecting fuel:	**1 hr**	**2 hrs**	**3 hrs**	**4 hrs**	**5 hrs**	**not collected**
No. of households: (n = 137)						
firewood	51	33	26	17	1	9
dung	25		1			111
ag residue	39					98

In seven villages, wood gathering by each household is the only method of obtaining firewood, as there is no wood offered for sale. Four of these villages are in the Casamance region, and they all have considerable forested area within a 5 kilometer radius. In these villages wood is usually collected daily or every other day, on foot; in Kagnobon, Manecounda and Maniora, the wife, or more often wives, of each household head spend between 2 and 4 hours gathering wood. In Bakadadji, on the other hand, it is customary for the men and older boys of the family to gather wood.

Loul Sessene, in Sine Saloum, also has numerous trees nearby, and firewood is abundant enough that the wife in each of the sample households can gather two or three days' supply of fuel for her family in about 2 or 3 hours. In Ndoga Babacar, which "like most villages of [Senegal Oriental] is surrounded by forest, the

furthest one goes for firewood is four kilometers." In the households surveyed, the men and boys collect all firewood, usually by taking a horsecart to the forest weekly or every two weeks and hauling back a large load. Ndoga Bobacar villagers occasionally sell wood in other towns.

Ndieye Sefour is the only surveyed village in the northern half of Senegal in which firewood is not available for sale. There is no real forest nearby, and for the most part, the cooking fuel used by villagers is "ngeer," the scrub bush which grows on the grazing areas around the village. Women collect the brush in Ndieye Sefour, and to alleviate the burden of lengthy searching and tiring chopping up of the small bushes, the several wives of each household either go together, or trade off woodgathering and cooking responsibilities so that each woman collects wood only for the days she is cooking. It is possible for Ndieye Sefour residents to buy wood from a neighboring village 4 kilometers away. Also, the men of the village occasionally take horse carts to collect large branches or trunks of dead trees, but this is rarely done.

Seven of the eight villages in which firewood is available for sale are in the northern half of the country, where deforestation is comparatively advanced and reliance on woodgathering alone is more difficult than in the south. In the eighth village, Mbaye Faye Mamadi in Sine Saloum, it is possible to buy wood, but in fact, according to the survey report, "Almost all the firewood that is cut for profit is sold outside of the village." Only two of the ten households surveyed buy any firewood, and then only rarely; more often the women find it sufficient to collect brush and fallen branches for an hour or two daily.

Likewise, even in those villages where buying wood is more common, not all households in the village choose to or can afford to do so. In Ndankh Sene, although wood is sold, none of the sample households bought firewood during the survey year (all of them supplemented their collected wood supplies with dung for at least part of the year). In Loro, Nguith and Ouarrack, some households studied regularly purchase their firewood while others usually collect it, but buy it when they have the money. In Nguith, men are the woodgatherers, and in Loro and Ouarrack the women do the gathering. In Bokhol and Ngueth, all households in the survey sample bought the majority of their firewood supplies, usually in small bundles several times per week. In some families, the women and/or children occasionally gathered brush to add to the purchased wood.

The Thiolom Fall households follow a slightly different pattern. Only one family in the village sells wood, which is brought from several kilometers away. All but one of the households in the survey sample buy cartloads of firewood, and all the households also collect brush. The large extended- or multi-family compounds in the Thiolom Fall sample purchase between two

and fourteen cartloads a year, storing the wood inside the compounds and then using it gradually along with the sticks, brush and dung collected daily within 3 kilometers of the village by the women of the household. According to the report, reliance on purchased wood is growing steadily in this village, as the distance traveled to gather it grows longer. Ten years ago, women could collect a day's wood supply easily within 500 meters of the village, whereas now it is necessary to go at least 3 kilometers.

The price of firewood appears to vary considerably among different areas of the country. In some villages reporting, the firewood cost rises in the rainy season; in others, variations may depend on the source of the wood or the identity of the sellers (e.g., villagers in Ngueth sell wood at one price to fellow villagers, and at a higher price to residents of nearby towns.) Differences in the cost of one charette-load, as recorded below, are probably due at least in part to varying charette sizes. "Bundles" of wood are sold in a number of sizes, and are often divided by bulk rather than weight; survey teams' weight estimates are therefore very approximate. Survey teams reported the following prices for firewood:

Table 13

FUELWOOD PRICES IN CFA FRANCS

Village	how sold	price (approx cost per kg)
Bokhol	bundle of 5 pieces	50
	charette	1100
Mbaye Faye Mamadi	bundle of 20 kg	250 (12.5)
Ouarrack	bundle approx. 5 kg	60 (12)
	charette	1000-2000 dry season 1500-2500 wet season
Ngueth	bundle	25
	charette	500
Loro	charette	5000
Ndankh Sene	bundle	125
Nguith	charette	1750
Thiolom Fall	charette	750
	bundle approx. 3 kg	100 (33)

Using firewood - cooking: Three meals per day are prepared and eaten in most village households (89.1% of the households surveyed). For a few families the morning meal is not cooked, but consists of cold leftover millet from the previous evening's dinner; over 80% of the families in the study, however, eat three cooked meals per day, and all but two of the 137 sample households cook these meals over a woodfire (the other two use charcoal exclusively).

Table 14

PERCENTAGE OF HOUSEHOLDS COOKING AND EATING VARIOUS MEALS

	1	2	3	K3
How many times a day are meals eaten?				
Eaten	0	8.0	89.1	2.9
How many meals are cooked per day?				
Cooked	1.5	14.6	80.3	3.6

Table 15

TIME SPENT COOKING MEALS

	Percentage of Households spending				
	no time	1 hr	2 hrs	3 hrs	4 hrs
Morning	13.1	66.4	16.8	3.6	
Noon		23.4	59.1	17.5	
Evening		13.9	54.7	22.6	8.8
Other meal	93.4	6.6			

Wives do all of the cooking in the households. They are often assisted by their daughters or sisters-in-law, but unlike wood-gathering, the cooking is apparently never done by men. In a few instances, households in the survey sample were without women for brief periods, the wives having left the village for work or visiting; in these cases a young female relative was "borrowed" to do the cooking during the regular cooks' absence.

Millet, which requires a long cooking time, is the staple food in all of the surveyed villages except Kagnobon, where rice rather than millet is the major crop raised for food. According to the descriptions of each household's typical meals, millet is generally cooked three times a day. Cooking times average 1.1 hours in the morning, 1.9 hours at noon and 2.3 hours in the evening. Around one third of the families interviewed said they buy and cook rice for the noon meal when they are able to afford it, both for variety and because it is faster and easier to cook. Millet must be steamed or boiled, and this is usually done in a large pot or couscousier (pot with steamer basket). In slightly more than 40% of the households, the cooking pots are set on three rocks over an open fire kindled on the ground. The other households either use a metal tripod as a pot support or cook in a pot which itself has metal legs to hold it over the fire.

Most of the households have a specific hut or room in which cooking is done, and in many cases there is also an outside fireplace for use in hot weather. Where the head of the household has several wives, each wife usually has her own cooking hut and set of cooking utensils. The kitchens are of several designs: a rectangular mud-brick room, freestanding or attached to a larger house; a round hut with mud-brick or millet stalk walls and a thatched roof; or a more elaborate two-level structure with a circular mud-brick "ground-floor" and a woven bamboo-walled grain storage room above. In the few households where all cooking is done outside, a screen or thatched shelter is often erected to protect the fire from excessive wind, or the the cooking fire is built against the mud-brick wall of a sleeping hut.

Using Firewood - heating, other: Heating is a seasonal use of fuel in Senegal. Only approximately one half (49.6%) of the households surveyed reported using any fuel for heating, and then only during the coldest months of winter, usually December through February. Both firewood and charcoal are used as heating fuels during the early mornings and the evenings in winter. In most cases, when wood is burned for heat it is either burned outside in the center of a compound, or extra wood is simply added to the cooking fire as people gather around to eat and socialize. In four villages the sample households heat only with cooking fires, and in two, the outdoor bonfires are the prevalent method of heating. Fifteen households in two villages report making small woodfires in the center of the head of households' sleeping hut in the evenings; these are the only reports of open fires inside buildings (other than in kitchens) and many families cited their fear of, or past experience of, burning down their houses as the reason for using other methods.

Aside from cooking and heating, there were few domestic firewood uses mentioned by survey households. Cooking fires provide light, but wood is rarely used only for lighting, except perhaps in courtyard bonfires, which are more often fueled with millet stalks or other agricultural debris.

Obtaining Charcoal: Charcoal can be purchased in eight of the fifteen villages studied; in the others, it is either made by individual users, bought in market towns or other villages, or used only when brought by guests or relatives. Charcoal-making in the bush (using earthen kilns or smothering log fires with dirt) is usually done by men, while the women make small amounts from their cooking fires, as described above. Among surveyed households using charcoal, most purchase the fuel within the village. (As mentioned above, few survey teams were able to provide precise in information about the origin of the charcoal sold. The villagers' reticence reflects their quandary; adherence to government requirements for permits and strict control of the charcoal industry is perceived by many to threaten their access to the fuel.)

In the households buying charcoal the most common practice is to buy it in quantities of 1 to 5 kilograms at a time, and the purchasing is generally done by any family member available. Large sacks of charcoal (50-100 kg) are also sold in some areas.

Table 16

CHARCOAL PRICES - CFA FRANCS

Village	How sold	price	price per kg
Kaynobon	2 kg tin	25	12.5
Bokhol	small pot	25	25
	large sack	650	
Mbaye Faye Mamadi	sack (5kg)	200	40
Ngueth	sack	400	20
Loul Sessene	sack (1½ x ½ m)	500	
Loro	sack	2500	
	kg	40	40
Ndankh Sene	kg	20	20
Nguith	2 kg pot	50	25

Using Charcoal: The charcoal is primarily used for two purposes, space heating and the brewing of tea, or occasionally, coffee. (Exceptions: As mentioned above, two households cook all their food with charcoal, and there were three occasions reported

when charcoal was used for ironing.) Making and drinking tea is an important social practice in many households. In some, tea is served every morning and/or afternoon, in others only when there are guests or on other special occasions, the frequency being governed by the availability of charcoal, tea or money to buy either or both. The tea is generally brewed on a small locally-made metal stove; stove designs vary somewhat, but they usually consist of a shallow bowl pierced at the base, or a grate, which sits over a cylindrical or square firebox with a flanged base to prevent tipping. Very small amounts of charcoal are required to boil a few liters of water, and although many villagers maintain that proper tea brewing requires the pot to be brought to a boil many times, the amount of fuel used averages .5 kg per day and rarely exceeds 1 kilogram. The heaviest use of charcoal for making tea was reported in Nguith, where some households brew it four or more times a day.

The use of charcoal for heating is widespread but extremely difficult to quantify. As mentioned above, many families do not build woodfires inside their houses or huts for fear of burning them down. They prefer to use charcoal for heating, but in many cases the "charcoal" consists of coals and partially burned wood taken from cooking fires, with perhaps a few pieces of "manufactured" charcoal added. The small stoves on which tea is made can be easily carried into sleeping huts to warm the inside air, and this is a common practice. Other families place hot coals in a metal or clay bowl or shallow pan lined with sand and ashes.

Obtaining Dung: In the 6 villages in which dung is used as a fuel, the women responsible for cooking their households' food collect cowdung from the areas where cattle graze, scooping it into baskets or tubs which are then carried home on their heads. This is often done in conjunction with woodgathering. (Dung used for fertilizer, on the other hand, is usually collected by men.)

Using Dung: Dung is dried and then added to woodfires for cooking, or rarely, heating. It is usually used as a supplementary fuel, although in Loro and Ndankh Sene some households reported cooking exclusively over dung on occasion.

Obtaining Agricultural Residue: Agricultural residues used in cooking and heating fires are collected from the village environs, either by women or more commonly, by children of the household. The most commonly used residues are millet stalks, which are abundant in the fields around most villages after the millet harvest. Corn cobs, tree bark, palm fronds and coconut shells are also burned where available. The sale of agricultural residue, in small bundles at 10 CFA/bundle, is reported in only one village.

Using Agricultural Residue: The residues are used to augment the woodfuel supply. Palm fronds, corn cobs and coconut shells are most often used for heating fires, while millet stalks are the

most common agricultural residues burned for cooking. Millet stalks were also reported in use in outdoor fires in the evenings. Specifically, the Koranic schools in some villages are held in the evening, and the young boys of the village (ages 4 to 14) often collect brush and millet stalks and carry them to the school gathering place to make a bonfire for heat and light.

Obtaining Kerosene: Kerosene is sold in small stores and/or by individuals in fourteen of the fifteen villages studied (residents of Manecounda must buy their kerosene in a neighboring village, half a kilometer away). Most households in the survey sample buy small amounts of kerosene, one quarter liter to one liter at a time. The task of buying kerosene is not specifically delegated; various members of the family buy it as needed.

The supply and distribution of kerosene appears adequate from the perspective of the villagers. Shortages were rarely reported during the survey year, and when they occurred it was usually only one or two days before the fuel was available in the village once more. One exception to this rule was in Ouarrack, where the usually dependable rail transportation from Louga was interrupted in August and September, resulting in more frequent shortages of kerosene during that time. Mbaye Faye Mamadi also experienced a shortage of kerosene during the 3rd quarter of the survey year. Residents bought their fuel in a village 5 kilometers away; the report explains that due to "a scarcity of cash (and other tradable products), none of the villagers who usually sell kerosene could afford to support the investment. This situation is also, in part, an effect of the rising cost of petrol products."

Kerosene prices rose over the survey year in most of the villages reporting. The rising cost of petroleum-based fuels worldwide was cited by several survey teams as the reason for the local increases, although it is not clear that this understanding is shared by all villagers. The per liter price in participating villages ranges from 100 CFA to 150 CFA; price increases were between 10 and 55 CFA and occurred at different times in different areas.

Buying kerosene from local boutiques, however, is usually more expensive then buying it in larger towns and cities, as local vendors cover their expenses by charging a higher price per liter then they pay for the fuel. In villages near enough to large towns, therefore, it is not uncommon for householders to buy kerosene in town when they go for other business, rather than obtaining it locally. Price differences of up to 30 CFA per liter were reported between village and town, and savings averaged 20 CFA per liter.

Table 17

PRICE OF KEROSENE PER LITER - CFA FRANCS

Village	Price in village at end of survey period	In nearby town	Increase over survey year
Kaynobon	115	100	
Ndieye Sefour	125	100	
Bokhol	100		20
Mbaye Faye Mamadi	100		
Manecounda		120	10
Ouarrack	140		20
Ndoga Babacar	140	110	
Ngueth	125	110	30
Soul Sessene	100		
Loro	120		20
Ndankh Sene	125		55
Bakadadji	130		50
Nguith	150		25
Thiolom Fall	120		20
Maniora	110		15

Using Kerosene: The only use reported for kerosene is domestic lighting. Most households studied use one to three small wick lamps for lighting the interiors of their houses and then only when eating or preparing for bed. In seventy percent of the households, kerosene lamps are burned for five hours or less in the evenings; over 50 percent use lighting only three hours or less during most of the year. Households with small children often keep one lamp lit throughout the night for easier childcare and a few households reported that older children studied by lamplight; otherwise, use of lighting, and therefore consumption of kerosene, is very low.

Variations in local architectural style, of course, affect the need for lighting equipment somewhat, (e.g., one room vs. multi-roomed houses, presence of windows, etc.) but the major variations in use of kerosene lighting appear to be seasonal. More kerosene is used during the winter months for two reasons: low outdoor temperatures and fewer hours of daylight. Cool mornings and evenings cause the villagers to spend more time indoors, where lighting is necessary, than they would at other times of the year. Likewise, the early darkness of winter days discourages the usual practice of sitting outside until retiring. Some survey teams reported that kerosene use is affected throughout the year by the phases of the moon, e.g., less fuel is used for lighting when the moon is full.

A few households have increased their lighting facilities by improvising additional lamps such as Perrier bottles with rag wicks, etc., but report that such equipment uses too much kerosene to be satisfactory.

Obtaining and Using Other Fuels: Candles are sometimes used in addition to kerosene lamps, or in place of them if the family is out of kerosene. Small shops in eight of the surveyed villages sell candles by the box (approximately 250-300 CFA) or singly (15-35 CFA). Flashlights are used by over 50% of the surveyed households, primarily for light while walking outside at night. Batteries for the flashlights, and for radios and tape players, are available in some of the villages studied, but are more often found in the larger market towns. They are expensive, and villagers often use the batteries first for radios and then transfer them to flashlights when they become weak.

There is some use of gasoline, propane and diesel fuel reported in four villages, although none of the households in the survey sample either bought or used these fuels during the survey year, and little information is provided about their specific use. These fuels are not sold in any of the survey villages. Gasoline is, of course, used as a fuel for trucks, cars and motorcycles; also, in one of the three communities where villagers fish from boats, a few men have gasoline-powered outboard motors. Propane is used for cooking and apparently some lighting as well. By December of 1980, diesel fuel was used to power millet grinders in seven villages, while an eighth village has a gasoline-powered grinder. In Bokhol, a diesel generator provides electric lighting in the area of the village mosque, the only use of electric power reported in any of the villages studied.

CHANGES IN FUEL USE PATTERNS

Several changes in patterns of fuel use occur regularly as a result of changes in season. Chief among these, as mentioned above, are increases in the amount of wood and charcoal burned for heating and of kerosene for lighting in the winter months. In many households, wood consumption is also increased due to frequent heating of water for bathing. Reports from three villages in sparsely wooded areas point out that the increased demand for wood in the winter prompts the men in many households to collect wood in horsecarts, with which they can range farther than the women normally go on foot and bring home larger logs for slow burning heating fires. Thus, the fact that more wood is burned does not necessarily mean that the usual woodgatherers must spend more time and effort at their task.

Another seasonal change affecting fuel use is the rainy season (usually late June through August or mid-September) during which wood use sometimes decreases. This is not a reflection of villagers' desire to use less wood, but simply a result of there not being dry wood available. Most villagers attempt to collect and store extra firewood before the first rains in June or July, and brush cleared from the family's agricultural land is also stored in anticipation of the rains. Several survey teams reported, however, that wood supplies did not last through the rains. Because most family members were working in the fields and had no time to search for wood, they simply cut down on cooking as a result. In other villages families which collect firewood during most of the year resorted to buying some of their supply in the rainy season. Unfortunately, few farming families have cash remaining by August and September from the past year's crop sales, so that this option is not available to all. Moreover, the cost of firewood rises in some areas during this season; in Ouarrack a cartload of wood which sells for 1500 CFA in the dry season costs as much as 3500 CFA after the rains begin.

Few options remain for those who cannot afford to buy firewood except increased time and effort spent looking for wood and/or reducing the amount of cooking done, an especial hardship when family members are doing physically strenuous work in the fields. During the dry season more villagers are resorting to collecting and burning dung, although it has meant overcoming strong distaste on the part of some. Even dung is unavailable during the rainy season in those villages where the livestock is herded to another region, although it remains an option in other communities, where animals are herded together inside or near the village.

Other seasonal or weather-related conditions affecting fuel consumption and availability include the hot dry-season winds (the Harmattan) which are extremely strong in some areas. Many women cook outdoors during this season, as temperatures are often in excess of 110°F, and their firewood burns rapidly in the wind,

causing them to use more than they do when cooking inside. In the hot dry months of April-June there are also occasional brushfires which denude the regular wood collection areas.

Some villagers suggested other events which might affect fuel needs and/or supplies, such as the religious observance of Ramadan. Because most of the villages are predominantly or entirely Muslim, the daylight fast for the month of Ramadan may considerably reduce wood consumption. Most families eat only one large meal each night, with tea or coffee before dawn; although children do not always keep the fast they are fed only unheated leftovers during the day. However, actual fuel measurements during Ramadan in 1980 do not show a consistent drop in firewood consumption, perhaps due to increased quantity and variety of foods prepared during the holidays. Other religious and family celebrations occasioned particularly heavy fuel use in survey households, but no appreciable pattern emerged from the observation of these events (marriages, baptisms, etc.).

Two of the villages surveyed, however, held events which do appear to have affected fuel use patterns considerably. A demonstration of stove-building introduced wood-conserving earthen stove designs to the villagers of Thiolom Fall (February, 1980) and Ndieye Sefour (July, 1980). In both villages, the demonstrations, or "stages" attracted much interest. Thiolom Fall households built 18 wood-conserving stoves in the month following the demonstration, including two in households in the survey sample "and now everybody wants one." In Ndieye Sefour, over 100 stoves were built as a result of the stove stage, and all seven sample households in the village began cooking with the new stoves (an eighth family participating in the survey had moved away from the village in May). The stoves were of simple design, usually without chimneys. In Thiolom Fall the households used them only part of the time for preparation of lunch and dinner; in Ndieye Sefour, the stoves were adopted with even more enthusiasm, as indicated by the following excerpt from the survey report:

> August, 1980: "July 10 - held a stove stage in Ndieye Sefour. By July 22 there were over 100 stoves in use/awaiting drying. Nearly every cooking hut has a stove and they are used for all meals regardless of pot diameter. The villagers chose the simple chimneyless model. Women did 90% of the work even though it was Ramadan and they were fasting."
>
> December, 1980: "Over 90% of the women have been using their stoves for the past five months - they do not use them for their breakfast, as the large pot which fits the stove is not used. They like the stove for a number of reasons: 1) economizes wood, saving them time...2) children cannot burn themselves accidentally on the cooking fire in the stove; 3) they do not have to worry about an occasional gust of wind throwing a spark from the cooking fire and igniting the grass hut...

the stove contains the fire; 4) the errant goat cannot overturn their pot when it is in the stove; and 5) the stove greatly reduces the time required to cook the meal, as the contained heat in the stove is hotter and cooks faster.

They recognize wood scarcity as a problem but they see the stove as a convenience and [have not concentrated on] using the stove as efficiently as possible (if it means more work, i.e., cutting the wood into small pieces to fit properly in the stove, covering the stove door, etc.).

The women use the stoves for lunch and dinner and they claim that the wood they would use for lunch on an open fire will now cook lunch and dinner in the stove. Their estimate is probably a little high - but the stove does seem to save consistently over 30-40%."

(Table 18 on the following page illustrates the impact of the wood-conserving stoves on fuelwood consumption among the sample households in Ndieye Sefour.)

TABLE 18

IMPACT OF WOOD-CONSERVING STOVES ON FIREWOOD CONSUMPTION IN NDIEYE SEFOUR, SENEGAL

Seven of the eight households in the Ndieye Sefour Survey Sample constructed wood-conserving stoves following a stove demonstration in July of the survey period. The readings represent the household wood consumption in kilograms over a 24-hour period. Readings below the dark line were made after the household began cooking with the Louga-style stoves.

HOUSEHOLD:	1	2	3	4	5	6	7	8
Size of hh:	9	11	8	8	22	14	10	5
READINGS:								
1. 1/16/80	21.0	23.0	27.0	10.5	37.0	29.5	16.5	11.0
2. 2/9/80	16.5	19.5	22.0	21.0	30.0	21.0	9.5	7.0
3. 2/18/80	17.0	19.5	26.0	29.5	32.0	25.5	13.5	8.0
4. 3/20/80	22.5	17.0	28.5	20.0	33.0	23.5	12.0	10.5
5. 3/27/80	24.5	17.5	11.0	20.5	35.5	34.0	14.5	11.0
6. 4/24/80	13.0	23.0	13.5	19.0	28.0	25.5	13.0	6.5
7. 5/17/80	16.5	17.0	13.0	15.5	28.0	18.0	14.0	
8. 6/24/80	8.5	13.0	11.0	12.5	18.0	15.0	15.5	LEFT
9. 7/24/80	11.0	11.0	8.0	10.5	11.5	13.0	8.0	THE
10. 8/16/80	6.5	9.0	8.0	6.0	13.0	10.0	7.0	VIL-
11. 9/26/80	7.0	7.0	7.0	7.5	15.0	11.0	7.0	LAGE
12. 10/22/80	6.0	11.0	10.5	7.0	9.0	10.5	10.0	
13. 11/19/80	9.0	9.5	13.0	10.5	10.5	7.0	6.0	
14. 12/20/80	12.0	11.0	15.5	12.5	13.0	6.0	6.5	
TOTALS	191.0	208.0	214.0	202.5	313.5	249.5	153.0	54.0
Avg daily wood consumption								
before stoves	17.4	17.8	19.0	17.7	30.2	24.0	13.6	
after stoves	8.6	9.1	10.3	8.7	12.0	7.2	7.4	
Per capita before stoves	1.9	1.6	2.4	2.2	1.4	1.7	1.4	
Per capita after stoves	1.0	.8	1.3	1.1	.5	.5	.7	

FUEL CONSUMPTION

From the survey teams' measurements of fuel consumption in each of the sample households, a figure was derived for each village showing an average household's consumption for cooking, lighting and heating, over a 24 hour period. The consumption figure represents the average amount of each fuel used by households in the sample, calculated on the basis of all households using the particular fuel. These figures are shown in Tables 19 - 22. (See notes on fuel measurement tables on the following page.)

As can be seen from the tables, firewood is by far the most frequently used cooking fuel, and kerosene the fuel most used for lighting. While charcoal, agricultural residues and dung were used by some households in the sample, there were many families using firewood and kerosene exclusively.

Kerosene consumption was found to be fairly consistent among different villages and throughout the year, averaging .12 liters, or 120 milliliters, per day. This low figure may explain why the surveyors did not find villagers extremely upset at the price increases which occurred during the survey year.

There is considerably wider variation in firewood consumption. The household average ranges from 20.5 kg to 5.9 kg in the first quarter of the year, and from 11.7 kg to 5.9 kg during the rest of 1980. Table 22 shows firewood consumption averages by month for each village reporting. In general, slightly more wood was consumed during the first quarter cold season than in the rest of the year, although three villages were found to have somewhat different patterns.

In two of the villages showing increased wood consumption after the first quarter, Mbaye Faye Mamadi (#4) and Manecounda (#5), heating fires in late November and throughout December account for the higher figures. The third village showing an increase in average consumption is Loro (#10), in Louga Region. Wood consumption in Loro increased markedly with the arrival of the rainy season, because cowdung was suddenly unavailable as a supplementary fuel. Each year, the Peuhl herdsmen who tend their own and other villagers' cows drive the cattle away from Loro when the rains begin, and do not return until December. This practice creates a profile of cooking fuel use in Loro quite different from villages where dung is not used as a fuel, and different even from other dung-burning villages. Tables 21 and 22 illustrate this contrast by showing cooking fuel consumption patterns in Loro and in Ndankh Sene, where sample households use both wood and dung throughout the year.

Notes on Fuel Measurement Tables

Fuelwood: It should be noted that the fuelwood figures in Table 19, Fuel Measurements: Cooking, and in Table 22, Firewood Consumption, include some wood used for heating and lighting as well. All fuelwood measurements have been combined for the computation of wood consumption averages. This was necessary because the survey teams were, in most cases, unable to differentiate amount of wood burned for heat and/or light from that burned for cooking, as the same fire was used for all purposes. One amount of wood was therefore recorded as used for "cooking and heating" or "cooking and lighting." As there were only a few instances where a separate fuelwood figure was recorded for each end-use, all fuelwood consumption is displayed in Table 19, and the symbol W used in Tables 20 and 21 to denote the fact that wood use for heating or lighting was reported.

Some further details regarding measured fuelwood use for heating and lighting: Sixteen sample households among five villages (#2, 8, 12, 13, 14) used their cooking fires for heating in January and February of 1980, and seven of these families continued using wood for heat through March. According to the narratives the most common practices are adding wood to the fire after cooking is completed, or removing hot coals from the cooking fire to place in sleeping rooms for heat. In three villages (2, 4, 5), heating with firewood began again in late November of 1980. According to the few instances where heating wood was measured separately, 1.5-3.5 kg per day are generally used for this purpose.

Firewood use for lighting was recorded in only three households, two in village #5 and one in village #8. Both families in village #5, Manecounda, used very little kerosene for lighting throughout the year; light for evening socializing, when needed, was from woodfires, and they used flashlights for other activities requiring light. The household in village #8, Ngueth, on the other hand, used kerosene lamps for most domestic lighting. Ngueth's Koranic school is held in this compound in the evenings, however, and when the bonfire of millet stalks and other brush collected by the boys of the household and by the other students is consumed, the household head adds wood from the family's cooking fuel supply. Again, as far as can be determined the amounts of firewood used for lighting are small, about 1.0-2.5 kg only.

Other fuels: Where measured charcoal use was reported for preparing tea or coffee, the average amounts used are shown in Table 19, Cooking. Where the end-use is heating, the figures appear in Table 21; however, in the instances where one amount of charcoal was used for "heating tea and room," the amount is included in cooking figures only.

Agricultural wastes used for heating were usually palm fronds and corn cobs, while residues used for lighting and cooking were almost always millet stalks. Diesel fuel was burned in kerosene lamps on occasion by a few households in Village #4.

Key for Fuel Measurement Tables

1 - Kaynobon
2 - Ndieye Sefour
3 - Bokhol
4 - Mbaye Faye Mamadi
5 - Manecounda
6 - Ouarrack
7 - Ndoga Babacar
8 - Ngueth
9 - Loul Sessene
10 - Loro
11 - Ndankh Sene
12 - Bakadadji
13 - Nguith
14 - Thiolom Fall
15 - Maniora

TABLE 19

FUEL MEASUREMENTS

Average 24 hour fuel consumption in sample households: cooking

	VILLAGE:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	No. hh	10	8	8	10	10	8	10	8	10	8	11	10	8	8	10
	Avg. hh size	8.5	10.9	11.8	9.1	9.9	9.9	7.3	12.6	8.3	16	9.5	11.6	8.8	13.9	7.1
1st Quarter	Wood	6	20.5	9.1	7.1	6.8	7.9	9.9	8.4	7.9	6.2	5.9	13.5	9.4	8.2	9
	Charcoal			1.2					.9	2.3	1.3			2.7	1.1	
	Ag. waste				1				1.1			2.7				
	Dung						2.2				3.7	4.3				
2nd, 3rd 4th Quarter	Wood	X	11.7	8.4	7.4	11.3*	6.6	X	**7.9	X	9.9	5.9	9.4	8.6	7.7	8
	Charcoal	X		.68				X	.75	X				.84		
	Ag. waste	X			.5			X	1.0	X						
	Dung	X					.4	X		X	2	3			.1	
	Avg. 1st quarter fuelwood per capita	.7	1.9	.8	.8	.7	.8	1.4	.7	1.0	.4	.6	1.2	1.1	.6	1.3
	Avg. annual kg fuelwood per capita	X	1.3	.7	.8	1.0	.7	X	.6	X	.6	.6	.9	1.0	.6	1.2

* 2nd and 4th quarters only
** 2nd and 3rd quarters only

TABLE 20

FUEL MEASUREMENTS

Average 24 hour fuel consumption in sample households: lighting

	VILLAGE:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1st quarter	Wood (kgs)					W										
	Kerosene (liters)	.1	.2	.1	.1	.1	.1	.1	.2	.1	.1	.1	.1	.1	.2	.1
	Ag. Waste (kgs)															
	Diesel Fuel (liters)				.03											
2nd, 3rd & 4th quarters	Wood (kgs)	X				W		X	W	X						
	Kerosene (liters)	X	.24	.12	.07	.18	.06	X	.18	X	.09	.08	.05	.11	.14	.06
	Ag. waste (kgs)	X						X	.8	X						
	Diesel Fuel (liters)	X			.09			X	.03	X						

W = Wood used for lighting and cooking, amounts included in Table 19 (also see Notes on Fuel Measurements page 40).

TABLE 21

FUEL MEASUREMENTS

Average 24 hour fuel consumption in sample households: heating

	VILLAGE:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1st Quarter	Wood (kgs)		W						W				W	W	W	
	Charcoal (kgs)								2						1	
	Ag. waste (kgs)	3.5			2											
2nd-4th Quarters	Wood (kgs)	X	W			W		X		X						
	Charcoal (kgs)	X						X		X				.67		
	Ag. waste (kgs)	X			.2			X		X						

W = Wood used for heating and cooking, amounts included in Table 19 (also see Notes on Fuel Measurements page 40).

TABLE 22

FIREWOOD CONSUMPTION - HOUSEHOLD AVERAGES BY VILLAGE

Village	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	JAN 81
1.	6.3	6.2	5.4	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
2.	21.9	18.5	21.0	17.7	17.4	13.4	10.4	8.5	8.8	9.1	9.4	10.9	nm
3.	10.1	9.6	7.6	7.4	8.9	nm	8.1	5.7	9.5	nm	8.8	11.0	nm
4.	7.6	7.4	6.2	5.8	7.2	7.0	8.1	7.8	7.6	7.2	6.9	8.6	nm
5.	2.4	9.0	9.0	10.6	9.4	9.6	nm	nm	nm	12.5	12.7	13.0	nm
6.	7.7	8.9	7.1	5.3	5.4	7.7	7.5	7.1	7.3	7.4	6.2	5.7	nm
7.	nm	11.4	10.1	8.3	nm	nm	nm	nm	nm	nm	nm	nm	nm
8.	nm	9.3	7.6	8.2	7.3	8.0	7.8	8.1	nm	nm	nm	nm	nm
9.	7.6	8.6	7.5	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
10.	10.6	4.5	3.6	2.1	3.6	13.3	13.1	11.9	11.8	11.2	12.9	9.0	nm
11.	5.6	5.9	6.3	6.6	3.9	5.8	4.0	6.5	6.9	7.4	5.5	6.1	5.8
12.	16.4	13.4	10.6	9.9	8.6	9.1	7.9	8.2	9.0	9.2	11.2	11.7	nm
13.	10.7	8.8	8.6	8.6	7.6	8.4	9.4	9.8	9.4	8.1	7.8	8.2	8.0
14.	7.1	8.9	8.6	7.3	6.1	8.2	8.6	8.3	7.0	7.5	7.8	8.3	nm
15.	10.3	8.4	8.3	8.0	9.4	8.3	10.3	8.1	6.7	7.4	8.0	8.4	nm

nm - no measurement taken

TABLE 23

USE OF WOOD/DUNG AS COOKING FUEL IN LORO DURING THE SURVEY YEAR

From July to early December, migrant herders take their cattle out of the area. Firewood consumption increases dramatically as a result of the unavailability of dung as a cooking fuel.

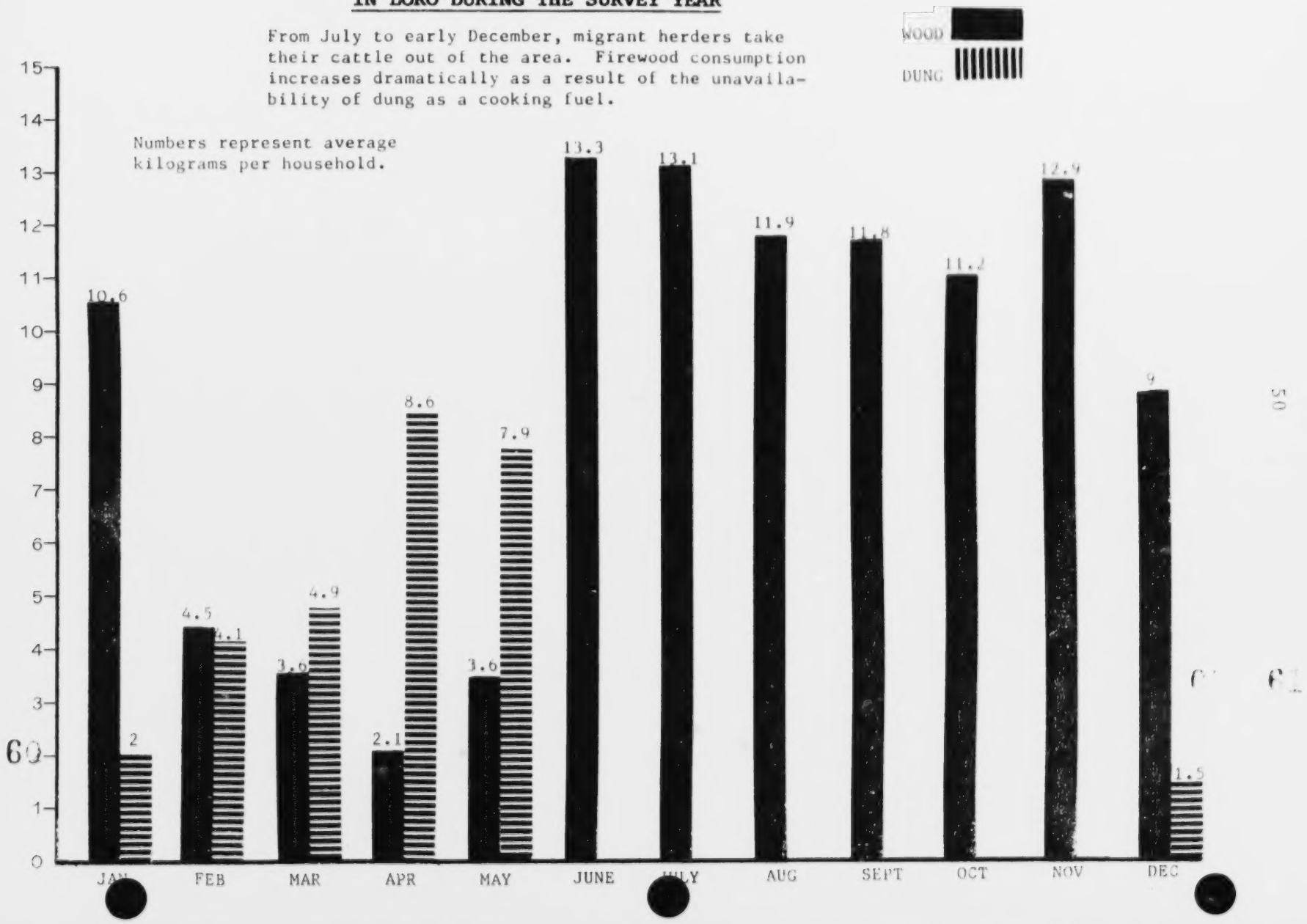


TABLE 24

USE OF WOOD/DUNG AS COOKING FUEL IN NDANKH SENE DURING THE SURVEY YEAR

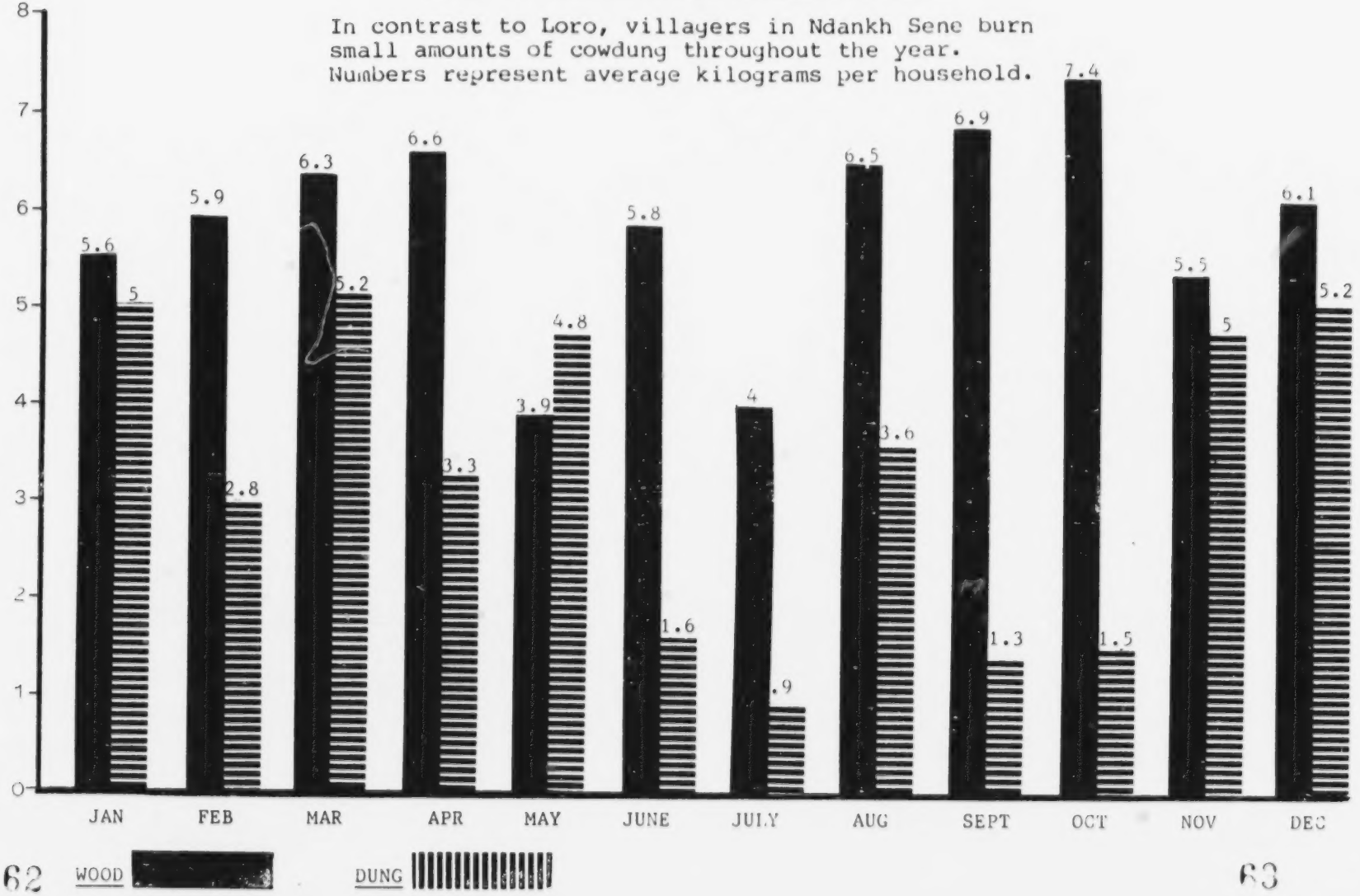
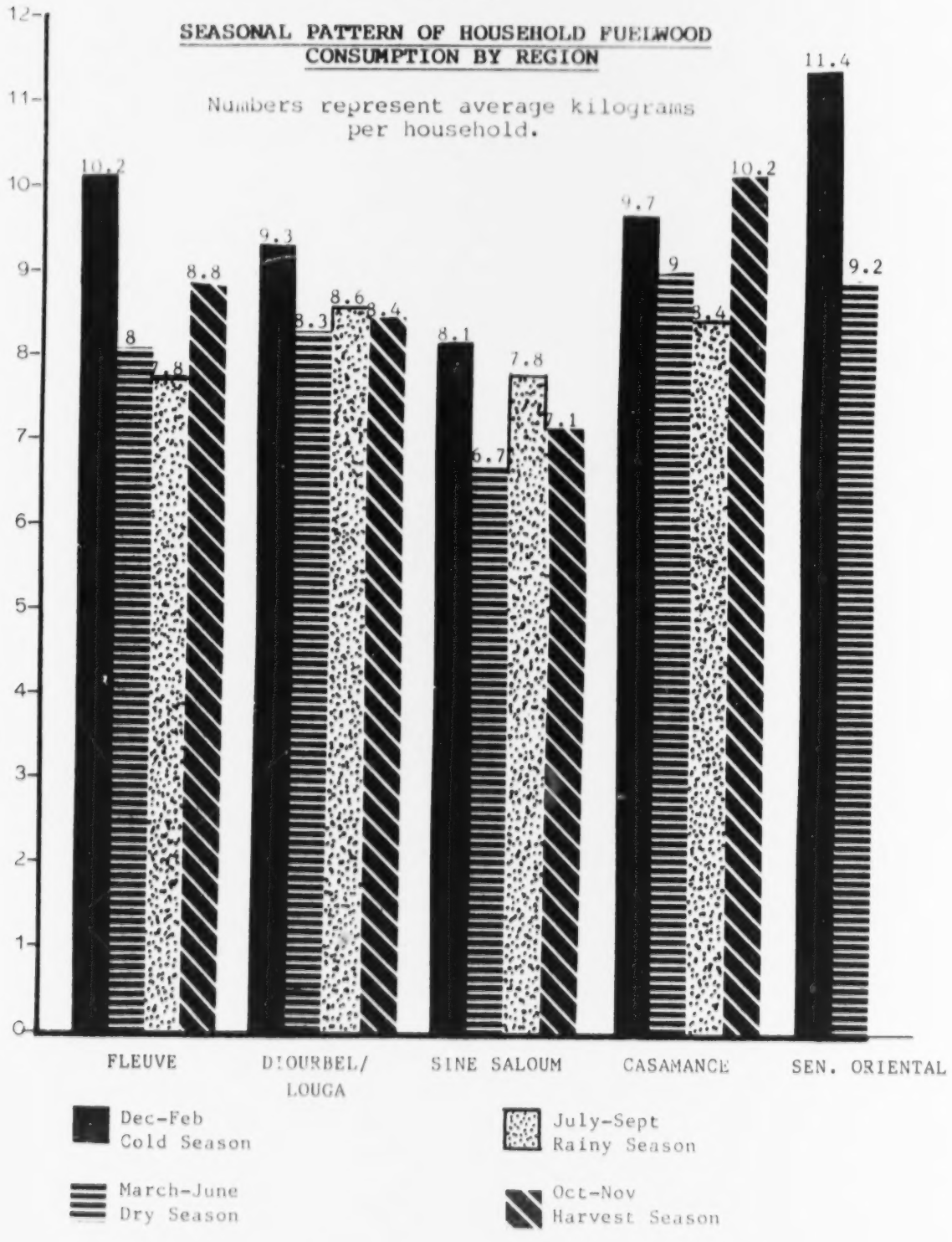


TABLE 25

SEASONAL PATTERN OF HOUSEHOLD FUELWOOD CONSUMPTION BY REGION

Numbers represent average kilograms per household.



Per Capita Firewood Consumption

Firewood proves to be both the most widely used fuel among our sample, and the fuel about which the villagers are most concerned. The dependency of rural dwellers on fuelwood, and the fuel's increasing scarcity, make it important to discover as precisely as possible the actual demands of the population on this scarce resource. Per capita fuelwood consumption was therefore calculated from the household consumption data, and is displayed in Table 18, Fuel Measurements: Cooking.

The average daily per capita consumption of firewood among the 137 sample households, in the first three months of 1980, was .98 kg. For the 107 households (78% of total) whose wood consumption was measured over the entire year, the per capita average was .83 kg per day, or 303 kg per year.

While there is still relatively little data available on rural fuelwood consumption in other developing countries, recent years have seen a number of studies which have produced per capita wood consumption figures. Table 26, on the following page, shows some of these findings. In comparing the other figures with the findings in the present study, it would appear that wood consumption among the Senegal villagers is approximately the same as that observed in Elizabeth Ernst's 1977 study of a similar rural population in Upper Volta (see below). Surveys conducted in other countries have yielded various higher and lower per capita figures.

Table 26

ESTIMATES OF DOMESTIC FUELWOOD CONSUMPTION IN RURAL COMMUNITIES FROM RECENT STUDIES

	Study	per capita kg/year	per capita kg/day
Senegal	present study	303.00	.83
Upper Volta	Ernst, E. 1977	306.00	.84
Nigeria	McComb, A.L. & Jackson, J.K., 1970	273.75	.75
Sudan	Digernes, T.H. 1977	*705.00	1.93
Tanzania	Fleuret, A and Fleuret, P., 1976	1636.00	4.48
Fiji	Siwatibau, S., 1978	**353.37	.97

* Data from appended analysis, 1978, p. 4.
**This figure represents fuelwood use for "home cooking and general preservation, etc."

Sources:

Ernst, Elizabeth, Fuel Consumption among Rural Families in Upper Volta, West Africa. Ouagadougou, 1977. 24 pp.

McComb, A.L. et Jackson, J.K., Le role des plantations forestieres pour la mise en valeur des savanes: aspects techniques et economiques (particulierement au Nigeria). FAO: Comite FAO de la mise en valeur des forests dans les tropiques, 2e Session, 1969. pp. 62-78.

Digernes, Turi Hammer, Wood from Fuel. Energy Crisis Implying Desertification. The Case of Bara, the Sudan. Bergen, 1977.

Fleuret, A and Fleuret, P. Fuelwood Use in a Peasant Community. In Journal of Developing Areas, Vol. 12, no. 3, April, 1978, Illinois.

Siwatibau, Suliana, A Survey of Domestic Rural Energy Use and Potential in Fiji. University of the South Pacific, Suva, 1978. 299 pp.

HUMAN AND ANIMAL ENERGY

Domestic Tasks

The surveyors found that several important and time-consuming domestic tasks are often done without the use of either traditional or commercial fuels. Because the villagers know of commercial fuel technologies for performing most of this work, they are especially aware of the demands on their own physical energy and time when performing them manually. Chief among these tasks are collecting water for domestic use and the grinding or pounding of millet and other grains which form the major part of the daily diet. Both tasks are performed entirely by women.

Collecting water: Only one village in the fifteen surveyed has a motorized pump for raising water from their (single) village well; in all the other villages, water for domestic uses - drinking, cooking, bathing, washing utensils and clothing and watering livestock - is raised and carried by hand. The major source of water in all of the villages is wells; while in Bokhol and the Casamance villages, the residents occasionally use river water for washing, the water in the Senegal and Casamance rivers and tributaries is salty for part of the year, and not usable for drinking.

There is a great deal of difference in the depth of the wells, and of the water table, among the villages in the study. In the four villages in the Casamance, Loul Sessene near the sea in Sine Saloum, and Bokhol, on the Senegal River, villagers draw water from wells less than 15 meters deep (average depth, 8.75 meters). Eight other villages have wells between 20 and 45 meters in depth (average depth 34 meters) and in one village, Nguith, the entire population gets all their water from one 73 meter well. Nguith is the village with a diesel-powered pump, which pumps the well dry in half an hour. Twice daily the well is emptied into a cistern, from which the villagers collect their water.

Women in every survey village go daily to the wells to fetch water in basins and buckets. In villages with only 2 or 3 wells they must often wait for a chance to fill their basins, and while the time spent at the well may provide a pleasant social time with other village women, many survey respondents complained of the hours involved in this task. The average time spent collecting water, among all surveyed households, is 2.7 hours; in a few villages it takes 7 to 8 hours, and in those situations every woman in the household joins in the task. In addition to the time involved, pulling the buckets or rubber bags full of water from a depth of 40 meters is understandably tiring, and the women are most anxious to alleviate this burden.

Table 27

DOMESTIC WATER CONSUMPTION CHARACTERISTICS

	Percent of households (n = 137)
1. Sources of water for domestic use	
stream	5.1
well	98.4
piped	0
rainfall	5.8
other	0
2. Treatment of drinking water	
untreated	65.0
filtered	35.0
boiled	0
other methods	2.2
3. Water heated for any purpose	61.3
Average number of liters heated per day: 7.6	
4. Time spent collecting water	
1 hour	19.7
2 hours	38.7
3 hours	12.4
4 hours	5.1
5 hours	5.1
6 hours	4.4
7 hours	4.4
8 hours	3.6
no response	6.6

Grinding grain: Even more than fetching water, the work of grinding/pounding grain is perceived by village women as a difficult task and one which they wish performed mechanically. Diesel or gasoline-powered grain grinding machines are available in most cities and towns, and in a growing number of rural villages in Senegal. Among the villages studied, four had grinders in the village at the start of the survey year, and three

communities acquired grinders during 1980. (In one case, the machine was "given by the Government;" the villagers contributed money and labor for a tin building to house the machine and a millet-stalk shelter for those waiting to use it. Another village acquired a grinder "as a co-op project for the women's association." Other reports did not explain how the machines were acquired, and none of the survey teams explained exactly how the commercial operation works; householders in the sample simply pay a fee - an average of 10 CFA/kg of grain - for the service.)

In every village without a machine, the women in surveyed households mentioned their desires and/or plans for getting one, because the manual preparation of grain by placing it in large wooden mortars and pounding it the heavy wooden pestles often occupies two to four hours of their time daily, and causes numerous physical complaints, from blisters to aching backs to exhaustion.

Even when a grinding machine is available, as the women pointed out, the grain must be pounded for some time before it an be processed by the machine. The food most often ground is millet, the staple in most communities and an extremely small hard grain. Because farmers store their millet "in the head," as harvested (the heads with their tight clusters of seeds are cut from the stalks, dried briefly and then packed tightly in a granary or storage chamber) the women must pound the heads to dislodge the grains, then to remove the hulls, break up the grains and finally to reduce them to powder. Only the final grinding of the dehulled millet is done by machine.

Rice, corn and other grains are slightly easier to process but still require a few hours for manual preparation. Other foods prepared with mortar and pestle in some communities include cassava, peanuts (ground for oil) and palm oil nuts. Usually, small amounts of these foods are ground as needed. In villages with mechanical grinders, the women often use the machine to grind the entire portion of the family peanut harvest not being sold, making several months' supply of oil at once. Oil from palm nuts is much prized for flavoring sauces; in areas where these nuts grow their harvest is usually followed by a few weeks of busy oil-making (a lengthy process of boiling, pounding, pressing, etc.) in which the women of several households may join in the work together.

Farming

In addition to the women's tasks of fetching water and grinding food, much of the agricultural work of these rural farming families is performed manually. Only one village in the study uses any fuel in farming; in the others, human and animal energy is used to perform all agricultural activities. In Bokhol, the SAED agricultural project provides diesel tractors and irrigation

pumps for tomato farming. Even in Bokhol, however, the non-project farming is usually done by humans and animals only.

Survey teams interviewed farmers in nine villages (three farmers in each village) about their agricultural practices; of the 27 men interviewed, 63% farm less than five hectares of any crop, and only 3 (11.1%) report landholdings of more then ten hectares altogether. Most of the farm land is close by the village - only 2 farmers work land farther than 3 km from their homes.

The farming season begins with the arrival of the summer rains in June or July. Preparation of the agricultural fields begins shortly before the rain is expected. Clearing the land is done by the farmer and his family in most of the farm households interviewed by survey teams; farmers with large landholdings (or small families) sometimes hire laborers to help them prepare the fields, but most often the hiring of field hands, when done, is reserved for weeding and harvesting.

The land must be stripped of any vegetation not already removed by women gathering brush for cooking fuel. In most of the surveyed villages there is little vegetation left by April and May, and the farmers either chop off the remaining grass and brush, or burn it and rake the ashes into the soil. Any wood and brush large enough to use for cooking fuel is carried to the compound and stored for use during the rains. Various designs of long and short-handled hoes and choppers are used in different regions of the country for clearing the land. Most have metal blades and wooden handles, and are used for hand-weeding as well as for clearing and breaking up the soil.

Most of the farmers surveyed (77.8%) use fertilizer on their fields. Of these farmers, 10% rely on commercial fertilizers only, while slightly less than one quarter use "homemade" or natural fertilizers exclusively. The remaining two-thirds use a combination of commercial and natural fertilizers. Fertilizer is usually applied before planting begins. The commercial fertilizers are almost always bought through ONCAD, the national peanut marketing cooperative which advances fertilizer and seed peanuts to farmers on credit. Some farmers explained that due to scanty rains in 1979, their peanut crops were small, and as a result, they were unable to afford any commercial fertilizers in 1980. Others intended to buy as many bags as they could (at 1250 CFA/50 kg for most varieties reported) and use the fertilizer on only part of their land, usually the peanut fields, while relying on natural fertilizers for their millet and other food crops.

The most commonly used natural fertilizer is animal dung, but ashes are used in some areas as well, especially when fields are cleared by burning as described above. Among the farm families interviewed, however, the only instances in which ashes were carried to the fields for fertilizer were in those villages where

rice is grown. In areas with enough water to grow rice (Casamance, Sine Saloum and Bokhol, on the Senegal River) the women usually assume responsibility for planting and tending the rice fields, and it is not uncommon for them to spread ashes from their cooking fires over the rice fields before planting.

The use of animal dung as fertilizer is more widespread; over 65% of the farmers interviewed use it alone or in combination with commercial fertilizer. In most communities a fair amount of dung is deposited on the fields throughout the year through the practice of tethering sheep, goats, and sometimes cows, in the fields during the dry season. By moving the animals every few days from one field to another, their dung is spread "automatically." Cattle, which are found in or around fourteen of the surveyed villages, are often herded rather than tethered. In many villages there is a community of Peuhl families following their traditional tribal occupation as herdsmen, tending their own cows and often those of other villagers as well. In most cases the cattle still graze and leave their dung either in or near the farmers' fields, but occasionally the Peuhl herders may take the animals farther away in search of good pasture, reducing the amount of cowdung available to farmers.

Many families also collect dung within their village compounds to use as fertilizer. In April and May, the farmers transport the dung from their compounds to add to that in the fields, and rake it to spread it evenly. The dung collected is usually horse manure, as it is mostly horses which are stabled within individual compounds. Horses are found in ten of the surveyed villages; not every family has a horse, but most reports indicate that about half of the households own a horse and cart. The carts are used to carry horse manure to the fields, and since the farmers pile up the manure throughout the year, by spring most horse-owning families have stored up 15-25 cart-loads to use on their fields.

While clearing and preparing the land is usually done by hand, most of the farmers interviewed use horse-drawn machines for planting, some weeding, and some harvesting (in a few villages oxen are used instead of horses to draw the machines). These machines, usually 3-bladed, open a furrow in the ground, drop seeds into it and close the furrow over the seeds. They can be used to plant both peanuts and millet, the major crops for most farmers in the study, through adjustment of the seed-spreading mechanism, and they are also used throughout the growing period to cultivate between the rows of plants (weeding between the plants themselves is done by hand using hoes or other hand tools). The seeders are also used by some to plant beans, corn, sorghum, etc., although rice, cassava, yams and other crops are planted by hand.

As most of the villages have no irrigation systems available, planting of crops is coordinated with the advent of the rains. The most commonly reported practice is to plant peanut fields

first, after the first one or two rains, and then to plant millet as soon as the peanuts are in, then other crops in order of their importance to the local diet (varies from area to area). In general, the farmers in all the survey villages follow similar farming practices. A representative example is a farmer in a village in Louga region, who recounted his schedule as follows:

> Five hectares of peanuts (a slightly larger than average field) are planted immediately after the first rain, usually late June or early July. Using two seeding machines, the farmer and his sons accomplish this in five days. Next, four hectares of millet are planted, requiring four to five days, and finally, the men take three days planting one hectare of beans - all using the same seeding machine. The seeder is then used to weed the crops in the same order, so that each crop is first weeded approximately two weeks after planting. Peanut fields are weeded four times during the growing season and millet fields, three times. The beans are cultivated only once using the machine, and then the farmer's youngest sons weed the field by hand. No herbicides are used, although the seed peanuts are dusted with a fungicide provided by ONCAD before planting, to prevent spoilage.

Among the farmers surveyed, almost all use this fungicide on their seed peanuts. Half of the men said they occasionally use pesticides, but only three provided specific information in this regard. Two men use Lindane, which they mix with millet hulls - the hard bitter covering of the millet seeds, removed via pounding with mortar and pestle - and spread around the base of each plant. Another farmer described a traditional practice designed to protect his bean crop from insect infestation: he covers the soil around each bean plant with tree leaves which have been dampened with water.

Harvesting routines are also similar from village to village. The peanut harvest begins between three and four months after the crop is planted. The entire family usually participates in harvesting, and other laborers may be hired as well. The plants are dug up using another horse-drawn machine which has a single blade; the blade of the machine plows up the rows of peanuts, turning the plants upside down to expose the tangle of roots and nuts to the air. As the plowmen unearth the peanut plants, the rest of the workers rake the lines of plants into small piles, where they are left to dry for 5-7 days. Then the small piles are consolidated into large piles up to 2 meters high, and the piles are beaten with sticks to separate the peanuts from the dried plants. The nuts are scooped up and tossed in the air to complete the threshing process.

> For the farmer described above, with 5 hectares of peanuts, the process takes approximately 50 days; fifteen days to plow up the plants (using 2 horses and 2 plows), 7 days for the

plants to dry, 10 days to rake the small piles into large ones, two weeks of pounding the piles with sticks and about 4 days for the women to do the final separation of nuts from hay.

Harvesting of millet is not done by machine. The heads of grain are cut from the stalks by hand, using a machete or other knife, only after the grain has been drying on the plant for 15 days or so, and the heads are left in small piles in the field to dry for another 2-4 weeks. Usually the small piles are collected into large piles for at least part of the drying period, to reduce the amount of crop loss from birds, insects, wind and foraging animals while the grain is in the field. Rather than completely threshing the millet at this time, most farmers store the millet in their woven bamboo or mud walled granaries still on the head, although partial threshing is accomplished by chopping the millet heads with sharp hoes and spades as it is packed into the granaries. Further processing of millet is done in small quantities throughout the year, as the women remove it from the granaries and prepare it for cooking.

Harvesting of other crops is generally done by hand, as well. Rice is cut with a small knife and dried in small bundles in the fields before threshing. Beans and corn are picked by hand, and cassava is sometimes dug up only when needed for food, as it keeps well in the ground. Most of these crops are stored in homes and granaries for the farming family's consumption, although small amounts may be sold in nearby market towns. The peanut crop, on the other hand, is usually sold immediately to ONCAD. Most families keep only a small portion of their crop to grind for oil and to use for next year's seed.

Most farmers in the study (81.5%) reported some crop loss during drying and storage. Much of this occurs while crops are drying in the fields, as described above. The farmers or their children try to keep birds and animals away by watching over the fields, erecting scarecrows, or ringing the piles of drying plants with thornbushes. In storage the main causes of crop loss are humidity (usually from insufficient drying, as rains are extremely rare out of season) and rodents. A few farmers use poisons to discourage rats and mice, but report little success. To combat insects and humidity, some people store the grain in or above their cooking area so that smoke from the cooking fires will help keep the grain dry and unspoiled. Others keep the grain in mudbrick huts on raised shelves, and kindle small fires from time to time in these granaries. For the majority of farmers, however, the only effort made is to dismantle their woven granaries each year for a thorough cleaning and drying.

C. ENERGY NEEDS AND RESOURCES

ENERGY CONCERNS AND IDEAS EXPRESSED BY VILLAGERS

Fuel Availability

When questioned, most of the villagers interviewed by survey teams admitted concern about the availability of almost every fuel they used. The immediacy of their concern is strongest in the villages in Louga, Diourbel and Fleuve regions, where there appears to be widespread recognition that the difficulty of obtaining firewood is increasing very rapidly. However, as survey teams had announced in introducing the project to their villages that one objective of the study was to heighten awareness and concern about fuel availability, it is hardly surprising that the villagers participating expressed such concern. It is from the answers to surveyors' open-ended questions about ideas and feelings regarding fuels that a more specific picture of villagers' concerns emerge.

In response to the surveyors' question, "Which fuels do [you] see as most crucial to meeting [your] daily needs? and why?", firewood was listed first in every case, and the reason given was that it is used to cook daily meals. (In several villages, heating and light were also mentioned as important daily needs met by firewood, especially in the winter months.) Some people said wood was most crucial "because it is free," while others insisted on wood's importance despite the fact that they now find it necessary to buy it.

While no villages reported firewood entirely unavailable, "shortages" were experienced in five communities, especially during the rainy season. Most often, the unavailability is expressed in terms of time and/or distance:

> "Wood, the major fuel, is always available, but only if one has time to look for it in the quantity needed. This time, though, is not always available. Gathering wood is women's work, as is almost everything else, hence they don't always have the time."
>
> "Wood is always available except for a few times during the rainy season (July-September) when no decent wood could be found in time to cook the meals. The rainy season is a very busy season and the women are more hard pressed than ever for time."
>
> "At this time people are busy in the SAED fields or personal fields and have no time to collect wood..."
>
> "...ten years ago firewood was ½ kilometer away, not 3 kilometers...."

"Wood [is] very scarce, but attainable. You either have to pay more, or travel further "en brousse" to find it. With each quarter [of the survey year] it becomes more difficult."

Price Increases

After increased time and distance, price increases of fuels were cited most often by villagers as a cause for concern. Wood prices rose in several villages; in one case the cost almost doubled. While only one report listed specific differences between dry season and rainy season wood prices, other comments indicate that seasonal and other temporary price increases are becoming more common. The price of charcoal rose in two villages over the survey year.

Ten villages experienced increases in the price of kerosene in the first quarter of the survey year, and two reported further increases later in 1980. Diesel fuel and gasoline also increased in price, and while these fuels are not sold in the villages themselves, the increase is or will soon be reflected in higher costs for millet grinding in the eight communities with mechanical grinders. The price increases for kerosene did not deter the households in the study from buying the fuel, although some families said they were "trying to cut down" on purchases. The cost of grain grinding, on the other hand, is a source of much concern among the women interviewed. Most said that they use the commercial grinders whenever they have the money to do so, regarding the savings in time and labor as more "valuable" than their money. This feeling was most often expressed by women in the three villages which acquired millet grinders during the year of the survey:

"The machine is such a labor-saving device that there is no complaint about the cost."

"no complaints.....because it is so time-saving."

"as difficult as [getting] money is, the women all manage to come up with the 30 to 50 CFA daily for the grinder."

Women in villages where a grinder has been available longer tended to express more concern about the cost of using it. However, the physical energy and the time required to grind grains by hand caused most of these women to use the grinder whenever they found it possible.

EFFORTS/RECOMMENDATIONS FOR ALLEVIATING ENERGY PROBLEMS

Few villages in the study have made changes in energy use as a direct result of scarcities and high fuel costs. In fact, among the villages surveyed the most common change in energy use over the past 10 years has resulted from the acquisition and use of the commercial grain grinders discussed above. Using the grinders actually creates more dependency on petroleum-based fuels, which are rising in cost most rapidly. However, the enthusiasm of the village women for these machines, to the point of contributing money for their purchase and upkeep in many cases, is definitely related to the women's major problem with fuelwood gathering, i.e., lack of time.

Among the survey communities, the villagers in Casamance and Senegal Oriental regions report the least problems with wood availability. None of these villages has a commercial grinder (although there is interest in the machines). On the other hand, all of the villages in Louga and Fleuve regions, where wood sources are most distant, either had or acquired grinders in . 80.

The only other recommendations made by villagers as to how they might combat fuel shortages were to make individual efforts to stock up on wood before the rainy season, to plant a few trees, or to get more money by sending family members to work in cities. Unfortunately, the situation in most villages is that "everyone recognizes the problems, but no one has a solution."

There have been some attempts by outside agencies to assist residents in alleviating energy problems. In addition to the introduction of fuel-conserving stoves in two villages, there have been several efforts aimed at increasing fuelwood supplies through tree planting. Few villages have had success with planting trees; in five communities where saplings were donated by international agencies or by the goverment forestry service's "one woman, one tree" program, the saplings died from lack of water, being eaten by goats, or, in one case, being ripped out by children. In other communities individual villagers have successfully raised nime trees for shade, and fruit trees for produce, but have not attempted any communal project or shared responsibility for fuelwood tree raising. Only one village reports a surviving 3/4 hectare plantation of eucalyptus seedlings by January of 1981, and in that community "most people feel that they will be eaten by goats once the grass is eaten."

The frustration felt by villagers as a result of their worsening fuel situation is reflected in their responses to the surveyors' questions about whether they would prefer different fuels to those they presently use. Most people said they would prefer to use different fuels, not because they disliked those they use (except dung) but because other fuels would save them time.

Propane gas for cooking was the most frequently mentioned, and while reasons such as cleanliness and rapid cooking were occasionally cited as advantages of gas cooking, time-saving was the most commonly expressed reason for wanting gas: "Propane would be a great time-saver,"; "they say they want gas in order to eliminate the endless search for wood." Electricity was mentioned almost as often as propane as the most desired fuel. Reasons for wanting electricity ranged from its producing "more light than kerosene," to a desire for refrigerators, pumps, and other "machines," to electricity's "status and simplicity." However, the villagers interviewed appear to be well aware that the cost of these fuels is prohibitive at the present time. Several explained that they know their responses to the question are "not realistic," but that they have no specific ideas about different fuels that they might actually afford. A number of responses were on the order of "anything which is more economical in terms of time ..don't know [of anything] but would like to learn." or "Any other energy source which would reduce manual labor."

RENEWABLE ENERGY RESOURCES

An important aspect of the energy survey is the evaluation of resource potential in the area surrounding each village for the introduction or expansion of renewable energy technologies. Solar, biomass, water and wind resources were investigated, with consideration of both present use of these resources and possible new ways of using them.

Solar Resources

As the country of Senegal lies roughly between 12°30" and 16°30" of latitude, the rate of insolation is quite high. The potential for using the power of the sun is further heightened by the fact that most areas of the country have very little cloud cover during most of the year. From October through early June, most of the survey villages experience only 1-5 cloudy days per month. Even when clouds appear they are usually burned off by mid-morning, so that in general, there are between 10 and 13 hours of sun per day (slightly fewer in winter and more in the spring). There is little natural shade in and around most villages, as trees are sparse and those which exist are often shorn of lower leaves and branches by firewood collectors and grazing animals. In fact, villagers expend considerable effort in creating small areas of shade, whether by tending and watering nime trees in their compounds or by erecting shelters of thatch under which to sit.

One characteristic, mentioned by three survey teams, which might diminish the power of solar energy available to a farmer or to a village is dust and sand in the air. Dust storms are common in some areas during the dry season, and the air becomes quite hazy according to survey reports. This dust probably diffuses the available solar energy somewhat.

The strong sun is presently used for drying crops after harvest (and for drying fish, in those communities near water). Also, when women take millet or rice from the family granary to prepare it for cooking they often spread the grain in the sun again to make it dry enough for grinding. Solar crop drying as practiced by the villagers studied is simple and traditional; grain (or entire plants) are spread on the ground or occasionally on platforms or mats, and turned or raked from time to time to promote even drying. There is much crop loss due to birds, animals, insects, and in several areas, wind. In addition, food grains are often covered with dust or sand by the abovementioned duststorms.

No use of solar energy for heating water, cooking, space heating or other purposes was reported.

Biomass

The information collected regarding village-area biomass resources includes rainfall patterns, vegetation, ownership and tending of livestock, soil conditions, ground water, and village experience with tree planting.

Rainfall patterns: The rainfall pattern is quite similar among all the regions of Senegal studied, although the amount of precipitation is highest in Casamance. The rainy season is "normally" from mid-June through September, although recent years have seen briefer rainy periods, or even no rain. During 1980, most survey villages had no rain from January through June, although a few unseasonal light rains ("sprinkles" in the words of one surveyor) were observed in five communities. These unusual showers lasted less than half an hour and "barely got the surface of the ground wet." The rainy season did not begin until mid-July, with rains every one or two days in the first two weeks, and then every 2-10 days through mid-September when the rains stopped abruptly. The villages in the southern half of the country had more frequent rains than those in the northern part, but not to any great degree according to the survey teams. Few actual measurements of rainfall were reported, although two villages in the Louga Region each reported a total rainfall of 300 millimeters.

The villagers anticipate the rainy season's arrival in mid-June, and consider it late if frequent rains have not begun by then. The very irregular rainy seasons over the past ten years have disrupted the farmers' schedules and caused poor harvests for many villagers, dependent as they are on the rains for all watering of crops.

Vegetation: The lack of rain and irregular rain patterns also contribute to the denuding of the land surrounding the villages. Growth of trees is retarded, and bushes and grasses die when the rains are late, if they are not already consumed as fuel, or by animals, or in brush fires. The survey villages in Fleuve, Louga and Diourbel regions already have very little vegetation of any kind in the immediate village environs, and in other areas of the country the villagers see the same pattern emerging, albeit considerably less rapidly.

The predominant vegetation reported around villages in Fleuve, Louga, Diourbel and Sine Saloum is scrub trees, thorn bushes, and grasses which spring up after the rains begin. There are numerous tree varieties but few actual trees; those which exist are often small and shorn of low branches by villagers and their livestock. In Casamance region there are more large trees, including mango, citrus and other hardwoods, as well as bamboo and coconut palms. Ndoga Babacar, in Senegal Oriental, is in a forested area, with over 50 varieties of trees, and there is abundant brush and grass in the cleared fields and pastures around the village.

Much of the agricultural debris which remains after the autumn harvest is used by villagers for fuel or other purposes. Peanut hay is stored in the compounds and fed to livestock. In most villages reporting, the peanut hay is used primarily to feed horses, but it is also given to cattle, sheep and goats during the rainy season in some communities.

Millet residues are used by villagers in a number of ways. Many households burn dried millet stalks for cooking fuel; women welcome the chance to substitute the easily collected and carried millet stalks from fields near their homes for the more difficult fuelwood. Outdoor millet-stalk fires in the winter evenings provide heat and light for socializing. The millet stalks are also widely used as construction material. In several villages each compound is fenced with millet stalks, and many sleeping and cooking huts are built of millet stalks as well. Millet hulls, the chaff from the millet pounding process, are often fed to cattle and sheep.

Other agricultural debris, such as corn cobs, rice hulls and branches from coconut palms, are generally burned in heating fires in the months following harvest.

Dung: Animal dung is another important source of biomass energy. Most of the villages in the study have a substantial supply of dung from residents' livestock. However, the dung is used extensively at the present time for fertilizer, cooking and heating fuel, or both.

Cow dung is the most common type of manure used for fuel. Only one village, Ouarrack, reports no cattle raised in or around the community. There are over 1000 head of cattle in each of four villages, and between 250 and 350 in five others. In the remaining five villages, fewer than 150 cows are kept by villagers. (Several villages include a community of Peuhl herdsmen in their populations. In some cases all of the cattle in the village are the property of this group. However, the Peuhls often tend cattle owned by other villagers along with their own cows, with various arrangements for compensation. In other villages three or four families may pen their cows together and share responsibility for tending them, or the cows may be cared for by individual owners. The cow dung, however, appears to be available for collection to anyone who wants it.)

Dung from sheep and goats is used primarily as fertilizer. These animals, like the cattle, are usually grazing in and around the agricultural fields during the dry season, and their dung is thus deposited directly on the farm land. Sheep and/or goats are raised in every village in the study, with three reporting 900 or more of the animals, and no village having fewer than 100. In Ourrack, which has no cattle, the villagers using dung as a cooking fuel apparently burn sheep and goat dung - this is the only place where this practice is reported.

Horse manure is a major source of fertilizer in the ten villages reporting substantial ownership of horses (between 50 and 560 animals). Horses are usually stabled near the villagers' houses; the manure is raked into piles in the compound throughout the year, and transported to the fields in charrettes in April, May and June to be spread over the land.

Farmers in seven villages also have donkeys, and two Casamance villages keep oxen instead of horses to draw charettes and agricultural machines. Five villages report large numbers of chickens (and ducks, in Bokhol). Finally, in the village of Loul Sessene in Sine Saloum, some villagers raise pigs. This is the only village studied in which pigs are raised; it is likely that Loul Sessene has a substantial Christian population, as opposed to the majority of survey villages which are predominantly Muslim (the survey questionnaire does not include specific questions about religion).

Water resources

As explained in the previous discussion of water resources for domestic use, water is in short supply in many of the survey villages. Village wells, which provide the only water available to the majority of the population studied, are for the most part barely adequate for present needs. Even villages near rivers or streams (Bokhol on the Senegal River, and Bakadadji, Maniora and Manecounda in the Casamance) rely on wells for most of their water, because of the increasing saltiness of the rivers. While most of the wells, whether relatively shallow (under 15 meters deep in 6 villages) or relatively deep (20-45 meters, 7 villages; 73 meters, 1 village) are usable throughout the year, the length of time and extent of human effort required to raise the water preclude the possibility of introducing new energy technologies which require water without better methods of obtaining this resource. For example: one of the reasons the survey teams investigated biomass resources was to evaluate the potential for the local production of biogas - methane gas produced through anaerobic decomposition of animal and vegetable wastes. However, biogas digesters require large quantities of water, as well as organic wastes. The minimal water resources in rural Senegalese villages, combined with the extensive use of waste materials at the present time for fuel and fertilizer, would appear to make the production of biogas an unlikely alternative energy source. If a means of providing adequate quantities of water were made available, it is possible that biogas technology might prove useful in alleviating shortages of cooking fuel and increased prices of kerosene used for lighting. Sludge from biogas digesters is even more valuable as fertilizer than unprocessed dung. Without increased water supplies, however, the technology is not feasible.

Soil

Few of the survey teams conducted extensive soil analyses. Again, the surveyors living in Louga region report that there is little or no topsoil remaining in the area around their villages. Wind and hard summer rains have eroded the earth, and in the absence of ground cover the soil is mostly sand, with occasional spots of hard clay. The Casamance villages of Maniora and Bakadadji, on the other hand, report 8-10 cm of topsoil, and the extensive growth of grasses and underbrush attest to the fertility of the land around these villages. In the forested area around Ndoya Babacar, to the east, the soil is also relatively rich and fertile - in the opinion of the survey team, "definitely better than much of Senegal. [and] No salt!"

Wind

Several of the survey villages do appear to have potential for wind-powered technologies. Eight of the sites are considered by residents to be quite windy, although the winds are not steady throughout the year, blowing most strongly from March to May or June and from October to December. As the topography is fairly flat in all areas surveyed, further investigation may find these villages suitable for the introduction of wind energy conversion systems, particularly for water pumping and for grinding.

D. SUMMARY

In summarizing the findings of the Senegal Rural Energy Survey, it may be useful to review the objectives of the data collection and to consider the questions the exercise is designed to answer.

As stated in the Introduction and Overview of the Survey workbook, a major goal of the project is the enhancement of existing knowledge about energy use, needs and resources:

1) "The survey aims at the production of detailed and valid information on the current uses of traditional and commercial energy sources by rural villagers in their daily lives: What kinds of energy are used? How are they used? What are they used for? How much is used? What are the social, cultural, and economic contexts in which they are used?"

Kinds of energy

The data collected by Senegal survey teams show a rural population relying primarily on traditional energy sources, most of which are locally available and are "renewable": human and animal energy; energy from wood and charcoal, agricultural debris and animal dung; and solar energy for crop drying. Of fossil-fuel energy sources, kerosene has by far the most widespread use, while diesel fuel, gasoline and propane are used directly by very few villagers in the communities studied.

Methods and End-uses

These kinds of energy are generally used, without processing or conversion, to accomplish tasks or functions essential to the daily lives of the villagers. While minor variations were reported, energy use patterns are generally as follows:

Human energy is most often used in manual labor (working by hand or with small tools, carrying). Most domestic work examined is done by women, and includes: raising and carrying water; grinding and pounding grains and other foodstuffs; collecting and carrying cooking fuel; cooking food; washing; child care and other domestic chores.

Agricultural tasks, most of which are performed by men, include: clearing land; applying fertilizer; weeding; harvesting; threshing; and tending livestock (herding, feeding, milking).

Animal energy is used for local transportation and for some agricultural tasks. Horses and donkeys are ridden or used to pull two-wheeled carts to carry people and goods. Horses, or oxen, are also used to pull farm machinery, principally seeding machines and plows used to harvest peanuts.

Energy from woodfuel, agricultural debris and dung is used by burning the fuels. Firewood is most often used for cooking, but is also burned for heat and light. The primary end-uses for charcoal are boiling tea and space heating. Agricultural residues (mostly millet stalks) are burned in woodfires as supplementary cooking fuel, and with wood or alone for outdoor heating and lighting. Animal dung is added to cooking fires. Most cooking is done in large pots set over open woodfires, while tea is boiled on small portable metal charcoal stoves.

Solar energy is used to dry crops in the fields after harvest and occasionally on mats or platforms in the compounds throughout the year. Grains, peanuts etc., are spread in the sun and turned or stirred from time to time to assure even drying.

Energy from fossil-fuels is used primarily for domestic lighting. Kerosene is burned in lamps and lanterns for light in almost every village household. Diesel fuel and gasoline powers mechanical grinders (and some water-pumps). Villagers in communities where these machines are operating generally pay for the mechanical services rather than using the fuels directly.

Fuelwood consumption

Villagers in the sample households surveyed used an average of .83 kilograms of fuelwood per person per day, or 8.6 kg per household per day. The average consumption of kerosene was 120 milliliters per household per day. Other fuels were used only occasionally in most households studied.

Contexts of fuel use

Most of the energy used for domestic tasks is consumed or expended by women. Fetching water, food preparation and the collection of cooking fuels are the responsibility of each married woman. However, in households consisting of several wives these tasks are often shared, and female children usually assist the women from an early age. Women often work together at pulling water from the village well and pounding grain with heavy pestles. Surveyors found fewer instances of women gathering wood together; more often the women of the household alternate days as cook, with each woman gathering fuel for her own cooking fires only. Likewise, entire compounds often trade off cooking duties, with meals for both groups being prepared at one compound for a few days, a

week or even a month, and then becoming the responsibility of the other concession for a similar period.

Most field work during the farming season is done by men and boys (with their draught animals when available) although the entire family usually joins in for harvesting and threshing. After the crops are sold or stored, many village men leave the community to seek work in towns and cities until the next rainy season, thus reducing both energy demands and available human energy in the village itself.

In addition to the division of labor, cultural influence on energy use is seen in such matters as tribal traditions regarding the acceptability of dung as a cooking fuel. In some villages only the Peuhl families burn dung. In other villages almost all households add dung to their cooking fires, while in still other communities villagers will not consider using it as a fuel. Surveyors found that some villagers are overcoming their reluctance to burn dung as firewood becomes more difficult to obtain without paying - thus, economic pressures may be overriding cultural tradition in this regard.

The agriculture-based economy of rural villagers has suffered in recent years as a result of crop failures or low yields caused by scant and irregular rainfall and poor soil conditions. Peanuts are the major or only cash crop for most villagers studied, and the sale of their peanut crop to the government cooperative provides the largest part of their cash income. Economic pressures on farmers and their families are further intensified by rising prices; world-wide oil price increases are reflected not only in higher local kerosene prices but in added transportation costs for virtually all goods brought into the village from any distance.

Survey teams did not collect specific information about household incomes and expenditures, land ownership, or similar financial matters of a sensitive nature. For this reason it is not possible to demonstrate with any precision the relationship of household income to energy use, i.e., whether families with more money consume more fuel, whether purchasing as opposed to gathering wood increases or decreases consumption, how the decision is made to spend money rather than women-hours in woodgathering or grain grinding, etc. Narrative data certainly suggests that in villages where wood is sold, increasing numbers of villagers are purchasing at least some of their wood supply - hardly surprising in light of the fact that, among the villages studied, firewood is sold only where gathering wood has grown difficult. Many families obtain their fuelwood in both ways, apparently purchasing wood when they have cash on hand and collecting it when there is no money.

Energy use for grain grinding presents a similar situation. The strength of feeling expressed by survey respondents indicates

that where possible, women definitely prefer paying for mechanical grinding to performing the entire task manually, although very few families actually used the grinder all the time. However, the lack of specific income data precludes any assumptions as to the relative importance of money, time, size of household, women's physical condition, distance from home to machine, etc., in villagers' choice of mechanical vs. human energy for grinding.

2) The survey also seeks to identify the energy needs of people in rural areas - in their homes, their small shops, their fields: What do people feel are their energy-related needs? How do they obtain this energy? What does it cost them in money, work, and time? How would they like it to be?

Most responses to survey questions regarding energy-related needs focus on replacing or reducing demands on human energy through increased use of other energy sources. Reducing manual labor is the priority, indicating once again that the time and effort required to accomplish daily tasks are burdensome costs to rural villagers. Although the majority of respondents still rely heavily on human energy for this work, they are familiar with alternative technologies by which the work can be done.

The technologies most often mentioned by villagers, those they have seen in nearby towns and villages, are fossil-fuel technologies: gasoline and diesel-powered water pumps, grinding machines and generators, and cookstoves fueled with liquid propane gas. In villages where these time and labor-saving devices are available, householders complain of their increasingly high costs. Where there is no access to the technologies, villagers expressed strong desires to try them, and voiced few doubts about their monetary costs relative to human-energy costs. In the case of grain-grinding, certainly the survey data suggests that while the monetary expense of fossil-fuel technology is quickly recognized as a problem, the savings in human energy is regarded as more important at least in the short term.

3) Finally, the survey aims at identifying and locating renewable, low-cost energy resources -- water, wind, agricultural and animal residues, and the sun -- available in rural villages and their surrounding areas which may be used as effective alternatives to costly and increasingly scarce commercial fuels.

Solar energy is abundantly available in most of rural Senegal. Wind energy appears to be present in the central and northern (especially coastal) regions for much of the year, while villages

to the south report little presence of wind. The southern communities are surrounded by relatively large amounts of vegetation, in comparison with the landscape of barren sand flats dotted with grass and scrub bush described in survey reports from northern villages. Villages in Casamance and southern Sine Saloum have a higher water table and shallower, more numerous wells then do the villages in Louga and Diourbel.

Agricultural and animal wastes are produced in considerable quantity; at present they are being used in considerable quantity, as well, primarily for cooking/heating fuel and for fertilizer.

built of mudbricks, wooden poles and grass thatch gathered from the immediate area, animals fed on the local vegetation and humans on the animals and crops they raised, water was dug for and raised from the ground, and fires for cooking, heat and light were fueled by trees and brush growing in and around the village. The villages were to a large extent self-sufficient communities; indeed, without adequate means of long-distance communication and transportation they must have been self-sufficient to survive.

In many rural villages life continues in the same patterns today. But self-sufficiency in such communities depends on a supportive natural environment, and the local environment of some villages in the study has apparently been damaged to the point that it can barely support the local people. Droughts and irregular rain patterns, excessive clearing of land, overcutting of fuelwood, overgrazing, and wind and water erosion can all be identified as contributing to the deforestation, disappearance of ground cover and deterioration of soil quality observed in a number of the villages surveyed. These conditions cause obvious changes in energy practices: woodgathering becomes more difficult as there are fewer trees, more distant from the village; some people tend to use more alternatives to woodfuels, such as millet stalks and cowdung, in order to cut down on the time and physical energy required to collect wood; others provide themselves more time for woodgathering by finding new ways of performing other time-consuming tasks, such as paying for machine-grinding of grain; still others choose to buy the wood itself.

Environmental pressures on other aspects of village life: At the same time that deteriorating environmental conditions are causing energy problems, however, the same conditions are also affecting villagers' food and water supplies, their health and sanitary conditions and their economic livelihood.

Food shortages were reported in several survey villages with severe deforestation. For most of the families studied, grain (usually millet) from their own fields forms the major part of their diet. Poor rains in 1979 damaged or destroyed crops in some areas, and without water for irrigation the farmers had no choice but to watch their crops wither and die. Even without the substantial post-harvest crop loss from mildew, insects, mice and rats, in many cases the food-crop yields were simply inadequate to last the household until the next harvest, despite the efforts of farmers to enrich the soil quality in their fields through the application of animal dung and commercial fertilizers. The fact that commercial fertilizers are bought on credit means that most they be used on the farmers cash crop, peanuts, in hopes of producing enough peanuts to be able to repay the cooperative. Food crops are likely to benefit much less from these fertilizers.

Lack of vegetation and topsoil exacerbates the problems of inadequate water by causing whatever rain does fall to run off

quickly rather than be absorbed into the ground. Ground water is not only deep beneath the surface, but it is also affected by the long dry season; water levels drop and in a number of villages one or two of the few wells supplying the village may go dry altogether before the next rains come. Even in communities to the south, where drought and deforestation are not as severe as in the central and northern part of the country, the level of water in the wells often drops during the spring, and in some cases the water becomes salty.

Villagers' nutrition suffers from both lack of quantity and lack of variety in the food. Millet, sorghum and beans are crops which can grow with a minimum of water, but the vegetables and numerous varieties of leaves which are cooked into sauces for millet are not so well adapted to the climate and may not be locally available year-round. In a large number of survey families the adults try to provide their children with three meals a day, while themselves eating only two, or even one meal. During the agricultural season, however, the adults need more food to sustain them through long arduous days of field work. Unfortunately, food supplies are often at their lowest at this time of year.

Limited water supplies also contribute to other health problems. The dependence of whole villages on a few wells, often unlined and usually uncovered, can lead to widespread transmission of parasites and other water-borne diseases. Many households interviewed complained of murky, dirty water in their wells, especially in the dry season. Some families filter their drinking water through a cloth to remove debris, sand, insects, etc., which fall or are blown into the well. Boiling water to purify it is rarely done; except for tea water and small amounts of water heated for bathing during the coldest months, the likelihood of villagers using their precious fuelwood supplies to boil water does not appear great.

The money economy of most communities studied is based on the production of one cash crop, peanuts. Peanut production, from the provision of seed peanuts to the purchase, storage and transportation of the farmers' crops, is directed through a national cooperative system. With centrally controlled costs and prices, the peanut market cannot always respond to local environmental conditions. Farmers may find themselves unable to break out of a cycle of poor crops and increasing debt and/or smaller investment in subsequent crops. The resulting shortage of cash decreases their opportunities to alleviate the energy, food and health problems described above.

USING THE SURVEY DATA AND METHODOLOGY IN PROGRAMMING APPROPRIATE TECHNOLOGY CHANGES

The information summarized in this report and in the individual village profiles gives a useful "before" picture of the particular communities studied. For this reason it would certainly be worthwhile to explore the possibilities for energy assistance projects in some of these communities. Not only have needs and resources been identified, but the opportunity to evaluate the impact of a project would be greatly enhanced.

At the same time, the survey methodology employed - specifically designed to increase awareness and understanding of energy issues among the villagers themselves - should provide a valuable advantage. By holding introductory meetings with villagers and by discussing a wide range of energy problems and alternative energy concepts with individuals and groups participating in the project, the survey teams worked to stimulate the villagers' concern and their imaginations. Basic to the concept of the survey design is the belief that it is the villagers' perspective, rather than anyone else's, which is important when recognizing needs for change and when choosing strategies for change. Success in any attempt to alleviate energy-related problems is unlikely unless the villagers themselves identify the problems and understand and support the plan for change.

The survey instrument and methodology may be useful in developing programming in other communities as well, through emphasis on this self-assessment concept. A new, shortened questionnaire designed to provide a means of rapid needs assessment in a variety of situations has been developed from the field-testing of the present year-long survey design. Self-assessment is hardly a new concept, but it is absolutely essential to the philosophy and to the process of introducing appropriate new technologies to communities anywhere in the world. The appropriateness of any technology to a particular community depends not only on the availability, usefulness and efficiency of the technology but on its harmony with the culture, social systems, politics, religion, economics, and physical environment of that community. Hence it is only the members of that community who can ultimately determine the suitability of a proposed technological change.

Development workers and government agencies can certainly assist in the determination process in all stages, using the energy survey design or other methods for needs assessment and helping villagers to weigh and prioritize their perceived needs and resources. Experience and expertise in alternative energy technologies will allow development workers to suggest possible avenues for meeting the identified needs, and to help the villagers explore possible consequences and ramifications of pursuing one route or another toward energy self-sufficiency.

Need for coordination of development projects

Just as energy problems are interrelated with other development problems, villagers and development workers alike must take into account that actions taken to alleviate energy problems will affect and be affected by efforts to solve the many other pressing concerns of rural dwellers. Attention should therefore be directed toward coordinating assistance programs as much as possible; failure to do so may result in duplication of effort, and can even lead to the unintentional sabotage of one project by another.

MATCHING IDENTIFIED NEEDS WITH SPECIFIC ENERGY TECHNOLOGIES

The energy problems most often mentioned by villagers participating in the survey are the need to reduce the demand for manual labor, and the need for easier access to cooking fuels. The specific tasks now performed by manual labor and seen as too demanding are: collecting and carrying firewood; lifting and carrying water; and grinding grain. The collection of firewood not only requires more time and effort in each succeeding year, but is for some villagers becoming close to impossible because there is almost no wood in the area around the village reachable by foot. Other fire fuels such as millet stalks and cowdung are often more accessible, but their use for cooking competes with other uses - fencing and hut construction in the case of millet stalks, agricultural fertilizer for dung. Charcoal is made in only a few villages although it is sold in eight of the fifteen, and wood can also be purchased in eight of the villages surveyed.

In selecting technologies which might prove workable as alternatives or supplements to present energy use in these areas, planners must bear in mind other major village concerns, as well as considering available local resources for energy technologies. In general, village needs include: improved soil for better crop yields; better crop storage methods; and increased cash income. The choice of any particular technology should be influenced by the potential of the technology to contribute to alleviating these other problems.

Resources most available include: solar energy, animal energy; and in a few sites, wind energy. Non-renewable energy sources (gasoline, diesel fuel, propane) are also available, if expensive, near many rural communities.

A working committee of villagers and local development workers might then consider the following possible matching of needs and technologies:

Task	Technology
Lifting water	animal traction pumping system wind energy pumping system mechanical hand/foot pumps - pedal, treadle, lever (diesel pumps) (solar pumps)
Grinding grain	animal traction grinder wind energy grinder mechanical grinder - pedal, treadle (diesel grinder)
Obtaining cooking fuel -	
reducing fuel demand	improved woodstoves with increased efficiency improved charcoal stoves with increased efficiency solar cookers, fireless cookers, ovens (kerosene, LPG stoves)
increasing fuel supply	village woodlots individual woodlots improved charcoal making techniques

Weighing the advantages and disadvantages of each technology, in consideration of the other needs of the village, we note that:

1) Substituting animal power for human power appears feasible;

   a) In most villages, draught animals (horses, oxen) are presently used for agriculture and transport only, while their numbers seem to indicate sufficient power for other animal traction mechanical systems.

   b) Animal traction systems would require little additional expenditure for animals or fodder.

   c) Most villagers appear familiar with the seeders and plows used presently. Blacksmiths could be trained to fabricate new machines, yokes, etc.

   d) Training and materials required to construct and operate the systems would require outside assistance.

2) Wind systems for water pumping and grain grinding may be appropriate in some villages, although they are technically sophisticated and relatively expensive;

   a) Specific data on wind regimes must be collected to determine feasibility.

   b) Urgent needs for more water could be met efficiently through water pumping wind systems in the right locations.

   c) Materials for the gross parts of windmill structures may be available locally, but internal workings - gears, bearings, etc., will have to be imported.

   d) Considerable training in operation and maintenance of the system would be required.

3) Pedal/treadle mechanical systems and hand pumps are inexpensive devices which would reduce, but not replace, manual labor;

   a) The increased efficiency of mechanical systems will reduce the time and effort required for waterlifting and grain grinding.

   b) Materials (bicycle wheels, sewing machine-type treadles, pumps) may be locally available at moderate cost.

   c) Operation of the systems is familiar to many; maintenance is relatively simple but would require training.

   e) Advantages of human-powered mechanical systems over diesel or gasoline-powered pumps and grinders will become more obvious as fossil-fuel costs continue to rise.

4) Solar powered pumps and grinders may be used experimentally;

   a) Photovoltaic technologies are very expensive at the present time, although cost reductions in the future may increase their attractiveness.

   b) If there is potential for outside agencies to bring in such technology, much work must be done to prepare villagers to maintain and repair such systems, which have little history of reliability in rural areas.

5) Improved cooking stoves are inexpensive and easy to construct and operate;

   a) Earthen cookstoves are already in use in some villages and appear both successful in reducing woodfuel demand and popular with villagers.

   b) An established dissemination system exists for earthen stoves (Ban Ak Suuf).

   c) There are minimal or no materials costs for earthen stove construction.

   d) Earthen stoves have non-fuel related advantages: faster cooking time; reduced fire hazard; reduced or channelled smoke and soot (some designs).

   e) Improving efficiency of charcoal stoves would require little materials cost (clay for insulation, etc.) but might require some training of metal-workers for possible design changes.

6) Solar and other non-woodfuel cookers may have limited use; of the range of technologies available, those necessitating the least alteration of cooking practices shoud be tried first;

   a) Insulated boxes (fireless cookers) can be made from inexpensive, locally available materials, require little maintenance, and could reduce fuel use by completing cooking of usual foods begun with fuel.

   b) Solar ovens are relatively simple to construct and operate, but are not well suited to the present cooking practices.

   c) Reflector cookers perform well in slow cooking of grains and vegetables, but require regular adjustment (orientation to the sun) and are complex and relatively expensive to construct.

   d) Kerosene and other fossil-fuel stoves are efficient and familiar to many villagers, but are expensive at present and are almost certain to become more so in the future.

7) Increasing available fuelwood, of necessity a long-term project, is the solution most likely to benefit rural communities as a whole and should be pursued concurrently with conservation and alternative energy technologies;

a) Reforestation will benefit villagers not only by providing firewood but also by improving their environment (soil and water retention, agro-forestry).

b) The major constraint is lack of available water, and new ways of lifting water must be explored.

c) Seedlings appear to be available to villagers at no cost from the government and/or other agencies at the present time.

d) Individual tree-planting has been successful in some villages, where financial incentives rather than fuel needs have motivated villagers.

8) Improved charcoal-making techniques must be coordinated with government programs and regulations;

a) Improving the efficiency of earth kilns requires training of operators, but little or no material costs.

b) Improved earth kilns and small CUSAB (charcoal from useless scrub and brush) - type kilns could provide more efficient use of fuel presently burned in open fires.

Selection of technologies clearly depends on a number of factors, including: priorities set by potential users; possible consequences of resource allocation or re-allocation for a new technology, expected efficiency of the technology compared to the cost; and compatibility with existing practices and attitudes.

VILLAGE RET CENTERS: A MECHANISM FOR INTRODUCING TECHNOLOGIES

Numerous methods of introducing Renewable Energy Technologies (RETs) to rural areas have been and are being tried throughout the world. One mechanism, which appears well-suited to many of the rural villages in the study, could be characterized as a "decentralized demonstration/dissemination center."

In such an approach, a small center would be established in each of a few selected villages to introduce, build and operate a particular technological device. Each center would demonstrate the RET best matched with the priority needs and resources of the particular village. The center could examine actual operating conditions and problems in that location, and experiment with any modifications necessary to adapt the technology for local use.

After demonstrating the successful application of one technological solution, other devices/technologies could eventually be introduced into the center to meet other local problems and concerns.

These small centers would serve as extensions of the larger, more sophisticated research centers already existing in the country. The large-scale research centers provide sophisticated experimentation and valuable data on efficiencies and durability of various devices. The need now is for particular demonstrations of the devices to potential users, combined with an active dissemination program to extend knowledge of the technologies throughout the local area.

The goals of the village-level RET centers, then, are twofold:

1. Demonstration, aimed at producing a specific and desired effect. The center should first address the most urgent problems of the specific community, as identified by the survey or a subsequent process. The eventual goal is to demonstrate a range of technologies and possible applications, in accordance with the concept of appropriate community technology: people making informed choices, for themselves, among available techniques for meeting their needs.

2. Dissemination of the technology throughout the village and to neighboring villages. By establishing centers in small villages access to their initial efforts may be somewhat limited, but successful demonstrations of ongoing RET use can form the basis for spreading the technology to other localities.

   Dissemination of RETs over a larger area can be accomplished through a combination of extension work by center

staff and the training of other villagers as extension agents within a larger geographical area. Training in construction and maintenance must be combined with training in communication in order to enable local villagers to be effective extension workers.

"Spontaneous" or word-of-mouth dissemination, often the best means of technology transfer, is in fact most likely to result from a number of small village-level demonstration centers. With continuing extension and training components the RET centers should provide wider and wider rural awareness of alternative energy and appropriate community technology.

Rural RET centers need not be large or expensive; one or two people per center with sufficient background and training in particular energy technologies, extension work and development theory, living and working in the village year-round, could form the basis of an effective demonstration and extension program. Sponsorship and funding for staff and materials would need to come from outside the village, as villagers struggling on a subsistence level cannot afford the money, time and risk involved in such an effort. Peace Corps Volunteers or other development workers from outside the village might form the initial staff, although emphasis should be placed on involving residents from the local area as soon as is feasible. Introducing RET centers in a few of the survey villages should facilitate local involvement almost at once.

The advantages to area villagers in having local centers is clear. Even with relatively simple technologies such as wood-conserving stoves, which can be successfully introduced in short-term demonstrations, it is often found that maintenance and repair problems require extensive follow-up efforts on the part of technicians, trainers and other development workers for the stoves to remain in use. More complex systems have sorrier histories. The permanent presence of RET expertise within the community can certainly help to alleviate these problems.

In addition, two important factors of rural village life which have bearing on the task of disseminating new energy technologies are amply demonstrated in the survey data: rapid rural communication "grapevines" and urgent interest in labor-saving technologies.

For example; the survey teams found that in general, most energy-related practices in villages today are little changed from ten years ago, and some have not changed for fifty years. Yet knowledge of diesel grain-grinding machines is widespread, the machines are quickly recognized as performing a valuable service, many villagers eagerly contribute money and effort towards acquiring them and families strain to pay for the service where available.

Diesel grinders may be perceived as modern, sophisticated, easy (in that the users do not have to operate or repair the machines), etc., but surely pedal or animal-powered grinders have as many or more "selling points," including simplicity, readily available power sources at no extra cost, and quite possibly more reliable performance. The survey findings certainly suggest that rural villagers will respond enthusiastically to a new technology which they see to be successful in meeting their needs, and that information about such technologies moves rapidly through the countryside.

In summary, the advantages of establishing small-scale village RET centers in selected survey villages lie in the combination of local demonstration and dissemination:

1) the centers will be accessible to the local rural population on a continuing basis;

2) successful demonstrations will provide visible proof that the new systems and devices actually work;

3) the demonstrations will also show the feasibility of construction, operation, and maintenance of the technologies in that particular location;

4) centers in villages which participated in the survey project can make effective use of the villagers' sensitization both to the energy needs of their community and to the concept of alternative energy technology;

5) the assessment of energy needs and resources in these sites has identified specific tasks and potential technologies with which to begin;

6) finally, the actual effects of changing energy practices can be measured, either against the 1980 survey findings or by other periodic observations, measurements, etc., the methodology of which may already be familiar to villagers.

Renewable energy technologies can alleviate some of the problems facing rural villagers in Senegal only if the technologies are accepted, understood and used consistently by the villagers themselves. The rural energy survey project offers an important opportunity to implement appropriate technology assistance in villages where a climate of energy awareness, specific identified needs, concerns and resources, and a profile of the present energy-use situation should contribute to success in alleviating pressing energy problems.

The following pages present in brief resume form the specific resources and concerns expressed in the fifteen surveyed villages, with suggested energy technologies for further consideration as starting points for RET extension center development.

VILLAGE: Kagnobon

REGION/LOCATION: Casamance Region
26 km from Bignona

SIZE: 1000-5000

MAJOR CROPS: peanuts
rice

FUELS USED: firewood - cooking, water heating
agricultural debris - outdoor heating fires
charcoal - tea
kerosene - lighting

WATER SOURCES: numerous shallow wells

CONCERNS EXPRESSED BY VILLAGERS:

- want mechanical grain grinder
- firewood getting further away
- fear of homes burning from heating fires

COMMUNITY RESOURCES, EXPERIENCE, ETC. RELEVANT TO ENERGY PROGRAMMING

- men's, women's, youth associations have worked on community projects

SUGGESTED TECHNOLOGIES/INNOVATIONS

- pedal power grinder
- passive solar construction to aid home heating
- development of community woodlot through existing active community groups
- charcoal making from coconut shells, other vegetation
- wood conserving stoves

VILLAGE: Ndieye Sefour

REGION/LOCATION: Louga Region
11 km from Kebemer, 25 km from seacoast

SIZE: 500-1000

MAJOR CROPS: peanuts
millet
beans
livestock

FUELS USED: firewood - cooking
charcoal (from cooking fire) - heating
kerosene - lighting

WATER SOURCES three deep wells

CONCERNS EXPRESSED BY VILLAGERS

- firewood scarcity, time and distance required to find it (source 2-4 km away)

COMMUNITY RESOURCES, EXPERIENCE, ETC. RELEVANT TO ENERGY PROGRAMMING

- stove demonstration well accepted, over 100 stoves built (7/80)
- successful growing of nime trees and eucalyptus saplings
- village acquired desired diesel grinder through women's cooperative effort
- strong winds in area

SUGGESTED TECHNOLOGIES/INNOVATIONS

- water pumping wind system
- animal traction for pumping, grinding
- community woodlot

VILLAGE: Bokhol

REGION/LOCATION Fleuve Region
on Senegal River, 10 km from Dagana

SIZE: 1000-5000

MAJOR CROPS: tomatoes (SAED project)
rice
millet

FUELS USED firewood - cooking
charcoal - heating huts, heating water
kerosene - lighting
diesel fuel - grain grinder, small generator (for mosque)

WATER SOURCES: wells, Senegal River (river is salty from May to July)

CONCERNS EXPRESSED BY VILLAGERS

- charcoal shortage in winter months (tomato farming done nine months of year, with irrigation, no time to find or make charcoal)
- credit system leads to lack of cash

COMMUNITY RESOURCES, EXPERIENCE, ETC. RELEVANT TO ENERGY PROGRAMMING

- SAED project provides irrigation pumps, fertilizers - villagers are familiar with them but have to pay

SUGGESTED TECHNOLOGIES/INNOVATIONS

- hydrams for less expensive irrigation
- wood conserving stoves
- improved charcoal-making technologies

VILLAGE: Mbaye Faye Mamadi

REGION/LOCATION: Sine Saloum Region

SIZE: 500-1000

MAJOR CROPS:
peanuts
millet
sorghum
corn
dairy cattle

FUELS USED:
firewood - cooking
charcoal - tea
kerosene - lighting
dung - cooking, by Peuhls only (1/3 of village)

WATER SOURCES: four 30 meter wells

CONCERNS EXPRESSED BY VILLAGERS

- shortage of kerosene in rainy season, 1980
- village has millet grinder but many cannot afford to use it
- want LPG for cooking

COMMUNITY RESOURCES, EXPERIENCE, ETC. RELEVANT TO ENERGY PROGRAMMING

- relatively near wood supply, villagers sell wood (and charcoal) to other villages
- dug fourth well, built pharmacy
- large livestock population

SUGGESTED TECHNOLOGIES/INNOVATIONS

- biogas digester
- pedal power/animal traction grinder
- animal traction for pumping water
- wood conserving stoves

VILLAGE: Manecounda

REGION/LOCATION: Casamance Region

SIZE: 100-500

MAJOR CROPS:
peanuts
fish and shrimp
millet
rice
fruit

FUELS USED:
firewood - cooking
kerosene - lighting
gasoline - some fishermen use for outboard motors

WATER SOURCES: five 11 meter wells

CONCERNS EXPRESSED BY VILLAGERS

- water murky from April to June
- debris in wells

COMMUNITY RESOURCES, EXPERIENCE, ETC. RELEVANT TO ENERGY PROGRAMMING

- wood relatively nearby, hardwoods and fruit trees
- on the water - fishing

SUGGESTED TECHNOLOGIES/INNOVATIONS

- new wells/improved protection of water supply
- expansion of fish and fruit production
- charcoal from vegetation
- wood conserving stoves

VILLAGE: Ouarrack

REGION/LOCATION: Louga Region
22 km from city of Louga, on railroad

SIZE: 1000-5000

MAJOR CROPS: peanuts
millet
beans
watermelon

FUELS USED: firewood - cooking
dung - cooking
charcoal - tea, heating huts
kerosene - lighting

WATER SOURCES: seven lined, fifteen unlined wells

CONCERNS EXPRESSED BY VILLAGERS

- water scarcity - wells in use 24 hours per day, need frequent redigging
- wood scarcity - increased reliance on buying rather than collecting
- soil - very poor, all sand
- crop loss - insects, wind, animals

COMMUNITY RESOURCES, EXPERIENCE, ETC. RELEVANT TO ENERGY PROGRAMMING

- adult education "alphabetization" program
- on railroad
- village got desired diesel grinder, formed 160 member women's group to maintain it
- strong winds in area

SUGGESTED TECHNOLOGIES/INNOVATIONS

- water pumping wind systems
- community woodlots
- solar grain dryers
- improved grain storage
- wood conserving stoves

VILLAGE: Ndoga Babacar

REGION/LOCATION: Senegal Oriental Region
38 km from Tambacounda

SIZE: 100-500

MAJOR CROPS: peanuts
millet
corn
cotton

FUELS USED: firewood - cooking
kerosene - lighting

WATER SOURCES: three wells

CONCERNS EXPRESSED BY VILLAGERS

- water scarcity - wells 16 years old, in bad repair, water is dirty, women spend 5-6 hours daily drawing water
- want mechanical grain grinder

COMMUNITY RESOURCES, EXPERIENCE, ETC. RELEVANT TO ENERGY PROGRAMMING

- near large wood supply (sell wood to other communities)
- farm communal peanut fields for money to maintain mosque
- good soil
- wind strong in some seasons
- large livestock population

SUGGESTED TECHNOLOGIES/INNOVATIONS

- pedal/animal traction grinder
- improve/protect water supply
- water pumping wind system/animal traction pump
- improved charcoal making technology

VILLAGE: Ngueth

REGION/LOCATION: Louga Region, Linguere Department
45 km from Linguere, 4 km from Dahra

SIZE: 100-500

MAJOR CROPS: peanuts
millet
cattle

FUELS USED: firewood - cooking, heating huts
agricultural debris - kindling, outdoor heating fires
dung - cooking (used only by some)
kerosene - lighting

WATER SOURCES: two deep wells

CONCERNS EXPRESSED BY VILLAGERS

- firewood is 15-30 km away, must be hauled by cart, most villagers buy it
- soil very poor
- water quality good, but wells very deep, difficult to raise water

COMMUNITY RESOURCES, EXPERIENCE, ETC. RELEVANT TO ENERGY PROGRAMMING

- village got desired diesel grinder
- villagers have built several cement latrines, well aprons (with help from Catholic Relief Service)
- strong winds

SUGGESTED TECHNOLOGIES/INNOVATIONS

- water pumping wind systems
- planting of woodlots and windbreaks (if more water available)
- wood conserving stoves

VILLAGE: Loul Sessene

REGION/LOCATION: Sine Saloum Region, near salt marshes, ocean

SIZE: 1000-5000

MAJOR CROPS:
peanuts
millet
manioc
rice
cattle and other livestock, including pigs

FUELS USED:
firewood - cooking, heating homes, bath water
charcoal - tea (infrequently)
kerosene - lighting
diesel fuel - small forage pump for garden project (run less than 1 hour per day)

WATER SOURCES: lined and unlined wells, 5-7 meters deep

CONCERNS EXPRESSED BY VILLAGERS

- need more wood in winter to heat bath water, in spring because strong winds fan the fires
- crop loss from rodents and insects
- debris in water, requiring filtering
- want grain grinder

COMMUNITY RESOURCES, EXPERIENCE, ETC. RELEVANT TO ENERGY PROGRAMMING

- men building watering trough near forage pump for animals
- large livestock population in area
- strong winds in area
- tree-planting failed because villagers did not water saplings, but village has water and 10 cm. top soil

SUGGESTED TECHNOLOGIES/INNOVATIONS

- pedal/animal traction grinder
- water pumping wind/animal traction system
- wood conserving stoves
- solar grain dryers
- improved grain storage
- improved/protected water supply
- woodlots

VILLAGE: Loro

REGION/LOCATION: Louga Region

SIZE: 1000-5000

MAJOR CROPS: peanuts
millet
beans
bissop

FUELS USED: firewood - cooking, heating homes
dung - cooking (January to June)
charcoal - tea (rarely)
kerosene - lighting

WATER SOURCES: two wells, 35, 38 meters deep

CONCERNS EXPRESSED BY VILLAGERS

- wood more than 40 km distant, hard to collect and expensive to buy
- don't like burning dung
- water scarcity - average 4.4 hours per day spent, lots of water drawn for animals
- villagers want electricity

COMMUNITY RESOURCES, EXPERIENCE, ETC. RELEVANT TO ENERGY PROGRAMMING

- eucalyptus tree planting project failed, lack of water
- strong winds in area
- got desired diesel grinder

SUGGESTED TECHNOLOGIES/INNOVATIONS

- wood-conserving stoves
- improved water supply (more wells)
- animal traction/wind powered water pumping system

VILLAGE: Ndankh Sene

REGION/LOCATION: Diourbel Region
25 km north of Diourbel, 9 km from Ndindu

SIZE: 1000-5000

MAJOR CROPS: peanuts
millet
sheep and goats, oxen

FUELS USED: firewood - cooking
charcoal - tea (only one household in sample)
dung - cooking
millet stalks - outdoor heating fires
kerosene - lighting

WATER SOURCES: four wells, 45 meters deep

CONCERNS EXPRESSED BY VILLAGERS

- water is salty and sandy
- women spend up to 7-8 hours drawing water
- soil very sandy
- want grain grinder

COMMUNITY RESOURCES, EXPERIENCE, ETC. RELEVANT TO ENERGY PROGRAMMING

- government primary and secondary schools have had coop garden projects in past
- government Bendez coop in village loans farm machinery
- people have expressed interest in tree planting
- large livestock population

SUGGESTED TECHNOLOGIES/INNOVATIONS

- wood-conserving stoves
- animal traction water pumping
- community woodlots (if more water available)

VILLAGE: Bakadadji

REGION/LOCATION: Casamance Region
43 km from Sedhiou, near river and salt marsh

SIZE: 500-1000

MAJOR CROPS:
rice
millet
peanuts
corn
fish
mangoes

FUELS USED:
firewood - cooking, heating houses, bonfire for Koranic school
kerosene - lighting

WATER SOURCES: numerous wells, 5-10 meters deep
(river is salty)

CONCERNS EXPRESSED BY VILLAGERS

- debris falls in wells
- want mechanical millet grinder
- want mechanical pumps, electricity

COMMUNITY RESOURCES, EXPERIENCE, ETC. RELEVANT TO ENERGY PROGRAMMING

- two cooperative associations, one very active, have farmed communal peanut fields and gardens to raise money, operate credit union
- private secondary school in village
- agriculture extension agent promoting rice project
- soil very rich

SUGGESTED TECHNOLOGIES/INNOVATIONS

- protect water supply
- pedal/animal traction grinder
- promote/expand crop diversification

VILLAGE: Nguith

REGION/LOCATION: Louga Region, 5 km from Linguere

SIZE: 1000-5000

MAJOR CROPS:
peanuts
millet
melons
bissop
cattle

FUELS USED:
firewood - cooking
charcoal - tea and coffee
kerosene - lighting
diesel fuel - millet grinder and water pump

WATER SOURCES: one well, 73 meters deep, with diesel pump which pumps the well dry in ½ hour (done twice daily)

CONCERNS EXPRESSED BY VILLAGERS

- shortage of water (sometimes have to bring it from Linguere)
- price of wood nearly doubled in 1980, collection source +8 km distant
- millet grinder is 15 years old, broken most of the time, too expensive for many

COMMUNITY RESOURCES, EXPERIENCE, ETC. RELEVANT TO ENERGY PROGRAMMING

- women's association makes crafts for sale in Linguere
- large livestock population
- "one woman, one tree" project tried, but saplings died for lack of water
- strong winds

SUGGESTED TECHNOLOGIES/INNOVATIONS

- wood-conserving stoves
- improved water supply - more wells, with wind or animal traction pumping systems
- pedal/animal/wind powered grinder

VILLAGE: Thiolom Fall

REGION/LOCATION: Louga Region
13 km from Kebemer

SIZE: 500-1000

MAJOR CROPS: peanuts
millet
beans

FUELS USED: firewood - cooking, heating
dung - cooking
kerosene - lighting
diesel fuel - millet grinder

WATER SOURCES: three wells, each 40 meters deep

CONCERNS EXPRESSED BY VILLAGERS

- no top soil, soil very sandy, little vegetation
- wood prices rising, more people buying
- cost of grinding too high at privately owned machine, want village-owned grinder
- don't like burning dung, forced to due to lack of vegetation (poor 1979 rains)

COMMUNITY RESOURCES, EXPERIENCE, ETC. RELEVANT TO ENERGY PROGRAMMING

- strong winds in area, especially March-June, Nov-Dec.
- wood conserving stove demo in 2/80, 18 stoves built by May
- tried two tree-planting projects, saplings died from lack of water or animals ate them

SUGGESTED TECHNOLOGIES/INNOVATIONS

- water pumping wind system
- woodlots (if more water available)

VILLAGE: Maniora

REGION/LOCATION: Casamance Region, on small river

SIZE: 100-500

MAJOR CROPS: peanuts
millet, sorghum
maize
rice
fish

FUELS USED: firewood - cooking
kerosene - lighting

WATER SOURCES: seven wells, 3-4 meters deep
river is salty, one well turning salty

CONCERNS EXPRESSED BY VILLAGERS

- difficulty in finding dry firewood during rainy season (wood supply is nearby and substantial)
- want mechanical grinder
- want to cook with charcoal or LPG to save time and labor
- crop loss due to humidity and rodents

COMMUNITY RESOURCES, EXPERIENCE, ETC. RELEVANT TO ENERGY PROGRAMMING

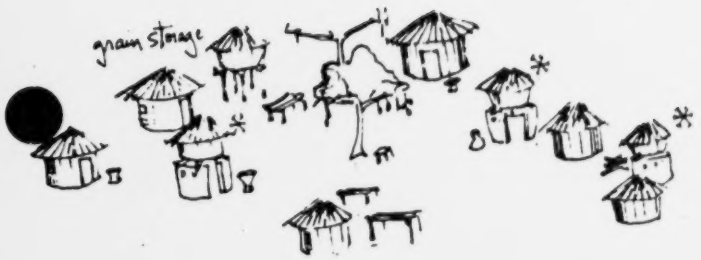
- wood sources less than 1 km from village
- men's credit coop, 2 women's credit coops (Diola and Mandinka), youth group - all have undertaken group projects successfully
- some households plant vegetable gardens, fruit trees
- soil is rich

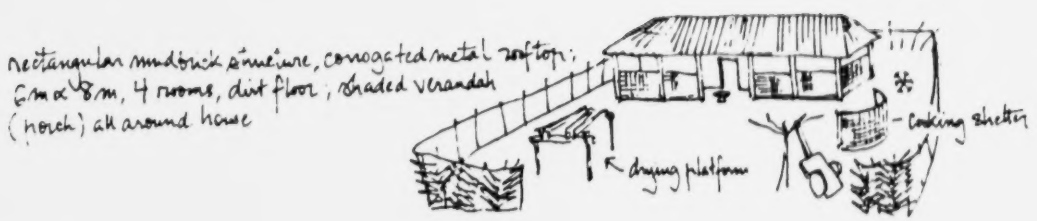
SUGGESTED TECHNOLOGIES/INNOVATIONS

- wood-conserving stoves
- solar grain dryers
- improved grain storage (also wood storage)
- improved charcoal-making

PROFILES OF SELECTED SENEGAL VILLAGES

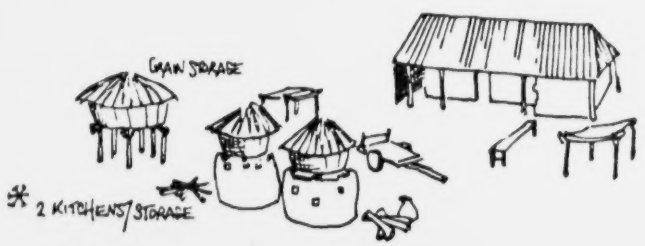
Based on Data from the Peace Corps
Energy Survey

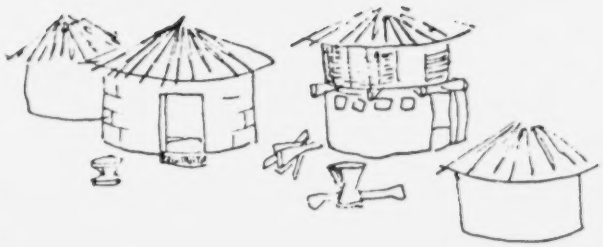



rectangular mud brick structure, corrugated metal rooftop;
6m x 8m, 4 rooms, dirt floor; shaded verandah
(porch) all around house
cooking shelter
drying platform

Patricia Riley
Energy Survey Coordinator
Office of Programming and Training Coordination
Peace Corps

December, 1981





Introduction

In November, 1979 the Peace Corps, with funds from a three year grant from USAID, initiated a survey of energy use and practices in a selected number of Senegalese villages. The purpose of the Peace Corps Energy Survey, which was also conducted in Micronesia, the Philippines and the Dominican Republic, was to design and test an instrument and methodology which would elicit detailed and valid information on the current uses of traditional and commercial energy sources in the daily lives of rural villagers -- in their homes, their small shops and their fields. The survey also aimed at identifying renewable, low-cost energy resources -- water, wind, sun, agricultural and animal residues -- which are available in rural villages and which might be used as effective alternatives to costly and increasingly scarce commercial and traditional fuels.

Data gatherers for this survey worked in teams of 2-3 people, a Peace Corps Volunteer, a local government representative and/or a village member. The survey, therefore, also resulted in an important learning experience for volunteers, host country development workers and village participants.

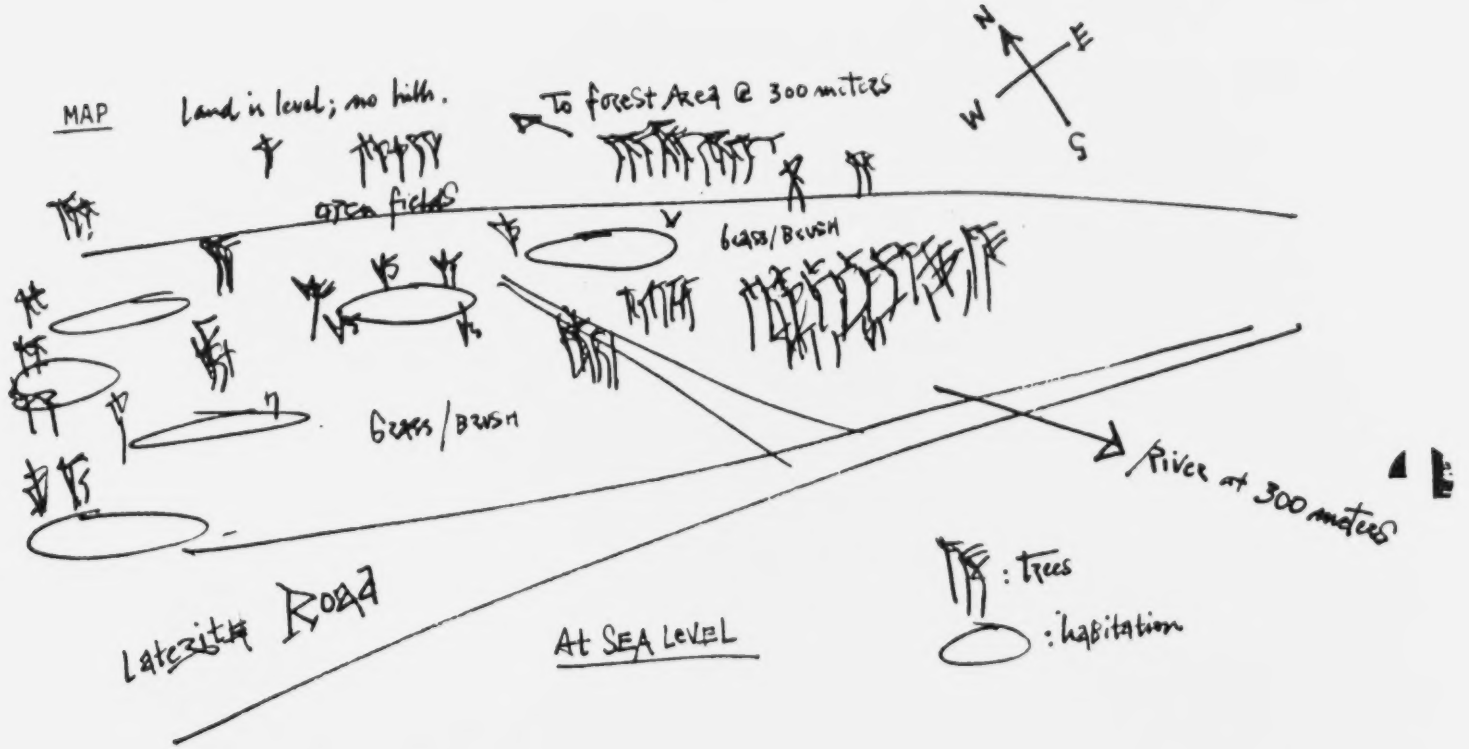
The survey instrument was divided into two major sections:

1) computable questions - which required a short numerical or yes/no response, and

2) narrative questions - which were open ended and included descriptions of practices, procedures and equipment, as well as, indications of villagers' attitudes and behaviors.

The village profiles which follow represent a summary of data found in the narrative section of the survey instrument with highlights from the computable data. We believe they give the reader a rich picture of village life and the social and cultural practices that surround energy use. They represent a useful first step for the identification of areas and existing renewable energy resources which may be ready for appropriate technological intervention.

Drawings by Mike Kidd, PCV, Manecounda Survey Team



Topographical Map, Manecounda, Senegal

Kagnobon

Kagnobon is a village of less than 5000 people, 26 kilometers from the town of Bignona in the Casamance region of Southern Senegal. Almost all men and women in Kagnobon farm the land surrounding the village; the men concentrate their efforts in raising peanuts, the main cash crop of Senegal, while the women do most of the rice growing, providing their families with their staple food. The growing season in Senegal depends on the arrival of the rains, which usually begin in late June. The first half of the energy survey year (January through June, 1980), therefore, found many villagers engaged in other activities to provide income.

Some of the men leave the village to find work in towns and cities, returning on weekends and holidays, others weave bamboo mats, and make "Casamance brooms" and furniture for sale or barter. Many build or repair their own and their neighbors' mud-brick houses or grass thatch roofs, or take their cow/ox-drawn two-wheeled carts to the forest areas 1-5 kilometers away, and haul back large amounts of firewood to store in preparation for the rainy season, when dry wood is difficult to find. These projects may be undertaken individually or in informal groups trading services, or workers may hire themselves out for room and board, and perhaps an agreed upon sum of money or goods, as field laborers do during the growing season. Actual cash wages are rarely paid in the village and cash income for most villagers is limited in this season to the money brought or sent by relatives in the cities.

Kagnobon has many organized associations, chief among which are a men's association, a women's association, a young married women's association, and a "jeunesse" or young people's association. In addition, the entire village, including those villagers who have moved to the city, belong to a "federation", with annual dues which are used for village development projects chosen at an annual meeting or "day of study". The Kagnobon federation has built a maternity center, a second primary school and a youth center (still under construction), and makes yearly purchases of drugs for the village pharmacy. The school in the village has regularly collected money from students, or sponsored a money-raising project such as buying a commodity in Bignona for resale in Kagnobon, although not enough money was collected this year to carry out their planned project of a school garden, so that the garden project has been slated for next year.

Many homes in Kagnobon are large, multi-roomed dwellings, sometimes shared by two or more families. A number of houses have tin roofs, fashioned to overhang the mud-brick walls sufficiently to provide verandahs, where during the dry season much of the socializing and eating of meals takes place. In fact, in the dry season

many families even use the verandahs for cooking, setting their large iron pots on metal tripods or on 3 large stones over a woodfire. In the rainy season the tripods are moved inside, usually to a room at the rear of the house, and meals are eaten in a large central hallway inside the house. (As in most villages in Senegal, men generally eat together, out of a single bowl, and women and children share another bowl either after the men, or in another part of the house/compound.)

The fuel of most concern to the villagers of Kagnobon is firewood, as they depend on it for all their cooking, and the collection of firewood has become more difficult and time-consuming each year. Each family has a general area from which they gather wood, but as most of the wood collected consists of fallen or dead branches, and it is gathered almost every day it is necessary to range farther and farther into the wooded areas to find enough fuel. Collecting wood is almost exclusively the responsibility of the women in the village, who must walk between 1 and 5 kilometers and spend 2-4 hours daily gathering fallen branches and carrying them home on their head. In the spring, the women collect more wood then needed for the day, and store the excess inside the compound to burn in the rainy season.

Again during the cold season, mainly December, January and February, more firewood than usual is gathered, so that water can be heated for bathing and heating fires can be built at night. Usually, the women heat a pot of water on their cooking fire after the meal is prepared, thereby making full use of the coals from the cooking fire, but the amount of firewood consumed in the cooking fires is definitely increased during this season, as the fire is fed until the water is "too hot for a Diola hand to touch."

As for heating of houses during the cold season, most families express fear of building fires inside their bedrooms for heat, and so they build fires outside the house and sit around the fires until they go to bed. The fire is always built in the same place so that the ashes can be easily collected and used to fertilize the rice fields in the summer season. A few families take small charcoal stoves, used for making tea, into their rooms at night, but even these families express apprehension about the risks of fire. The fuel for the outside heating fires is generally fallen palm stalks (the pithy central rib of the leaves of palm trees) as it is recognized that hardwood is too precious (and too difficult time/work-wise) to be burned for this purpose. The palm stalks and other agricultural debris are found in and around the village itself, rather than in the forest, and are most often gathered by children each afternoon for that evening's fire.

Aside from the light from the heating fires, most families use between one and three kerosene lamps to provide light for the evening's activities. Kerosene for the lamps can be purchased

from small village boutiques at a cost of 115 CFA/liter, but some families prefer to buy kerosene in Bignona, where a liter is 15-20 CFA cheaper. The head of the household will often cycle the 26 kilometers to the larger town as often as once a week to fetch it. Alternatively, villagers can go to a village 6 kms away and buy it for 5-15 CFA less than in Kagnobon. Of course, Bignona is the nearest major market town to Kagnobon, and presumbly these trips are undertaken not only to buy kerosene but also for other commodities not available in the village.

One fuel used in some quantity in many parts of Senegal is charcoal, for making tea and ironing clothes. Kagnobon families apparently use very little charcoal; it is sold in village boutiques, at 25 CFA for a 2 kilogram canful, but most families find or make their own, in the forest, or rely on visitors to bring them some.

All of Kagnobon's water supply is drawn from wells, most of which are "traditional" earth-lined wells, although a few are lined with cement. Because of the number of wells and their proximity to the houses of the village, collecting water for daily domestic use requires only about one to three hours. The women of each household, including any daughters old or strong enough, draw the water from the well and carry it to the house in pails balanced on their heads. Some of the water is then stored in the pails, and in clay or metal basins, while water for drinking is filtered through a piece of white cloth and stored in clay storage jars distributed throughout the house. The women usually fetch water early in the morning, and then again in the late afternoon. A few of the village wells dry up in the spring, and some are used only for washing and watering livestock and gardens, but the villagers seem generally content with the potability of their water.

In addition to collecting and transporting firewood and water to their houses each day, the village women spend considerable time in food preparation. The staple food of the village is rice, usually stored in one or two rooms of the house after harvest, still tied in the small bunches in which it is taken from the fields. Many villagers light fires periodically in the grain-storage rooms, to keep away rodents and to dry out the rice. Further drying is needed, so the women lay the bunches in the sun on a raised platform outside the house for a day or so before using the grain. When the rice is sufficiently dry, it is first winnowed with the feet on a mat and then the rice only is placed in a large stone or wooden mortar and pounded with a heavy wooden pestle to de-hull it and prepare it for cooking. As this pounding is regarded by the women as extremely tedious and tiring, the work is shared by all the women in the household, and they generally try to prepare two days' supply of rice at a time, spending 2-3 hours every other day at the task.

During the survey's second and third quarter there was another staple food requiring lengthy preparation, palm oil, which is used in sauces. The palm oil nut is first steamed for an hour or so, and then placed in the mortar and pounded to extract the food necessary for a sauce which is cooked for another hour. Palm oil requires many hours of boiling the sauce and is usually done communally once or twice a year, depending on availability of nuts. Another oil, form the inner kernel of the nut, requires even further pounding and is therefore prepared only once a year.

The main meal in Kagnobon is eaten in the middle of the day. It generally consists of rice and palm oil sauce (with lemons and/or tomatoes) or manioc or hibiscus leaf sauce, and fish, either dried or fresh. The evening meal is rice with a similar (or the same) sauce, left over from lunch, or with millet, but many times it is only rice. Breakfast is either plain rice, rice porridge made with milk and sugar, or occasionally pounded millet with milk and sugar. In order to prepare these meals, Kagnobon women must actually cook at least four times per day, as the palm oil nuts and the fish are cooked twice. When, as is common, the head of the household has more than one wife, the women alternate the responsibility of cooking and gathering firewood. Water carrying, like the pounding of rice and palm nuts, is a task shared among all the women and their daughters.

N'Dieye Sefour

N'Dieye Sefour is a small village on the flat sandy Sahelian plain of Northern Senegal, 25 kilometers west of the Atlantic coast, and 11 kilometers from the city of Kebemer. As is true in most Senegalese villages, the residents of N'Dieye Sefour are all farmers during the rainy season, raising peanuts as a cash crop and millet, beans and melons to eat. But because the rains are slight and unpredictable in Northern Senegal (between 4 and 10 rainstorms between July and September) almost all the villagers raise livestock for sale and barter, to supplement their income from the sale of peanuts. A few families raise only chickens, but most keep goats, cows, sheep and/or breeding horses. Due to poor rains in 1979, the villagers' peanut crops were small, and the sale of animals was the main source of income for most people during the 1st half of the energy survey year (January-June, 1980). The millet and bean crops were also small (11% of the previous year's) and most families had to buy food in Kebemer.

While providing necessary income to the village, the combination of farming and "elevage" (animal raising) places some strain on the meager resources of N'Dieye Sefour, particularly its firewood and water supplies. After the rains, the fields surrounding the village are dotted with clumps of grass, small bushes and scrub trees. There are very few large trees in the area, except those planted for shade in the village compounds. What hardwood trees there are are "dying at an alarming rate due to all the branches [being] cut off for various reasons: feed goats, construction of huts, and infrequently, for firewood." The bushes and scrub trees are the village's main source of firewood for cooking, and for heating during the months of December, January and February.

Each morning the village women, usually taking their children with them, travel 2-4 kilometers away from home to gather sticks and branches, spending 2½ to 3 hours cutting the day's supply of wood. The fields are also grazing land for the village's 500 goats, 150 cows, 100 sheep and at least some of the more than 60 horses. Between the wood collectors and the animals eating leaves and twigs, the brush is likely to disappear before the end of the dry season, forcing both groups to range farther away as the season progresses. Then, in June, any ground cover left on the fields is cleared (cut or burned) by the men of the village in preparation for planting. "There are times during the rainy season when villagers cannot cook because there is no firewood." In addition, the close grazing/brush collecting makes it easy for the dry season dust storms and strong winds of the rainy season to blow away topsoil, further diminishing the fertility of the land.

The village itself has two sections, or quartiers, about ½ kilometer apart. Separating the quartiers is a sand ridge

approximately 10 meters high, on either side of which are the village wells, two in Quartier 1, one in Quartier 2. The only source of water N'Dieye Sefour, the wells are 40 meters deep and are usable year-round, although the water level is quite low in the dry season and they can be "pulled dry" with heavy use. Women from each compound pull up the water in rubber bags fastened to a rope on an overhead pulley, and carry it back to their homes in metal basins. The basins, carried on the head, hold 25-30 liters, and the households use an average of 370 liters daily (ranges from 200 to 750 liters) The women spend between one and three hours at this task. Twenty-five to fifty percent of the water drawn is given to the livestock.

In each quartier of N'Dieye Sefour the men collected money and contributed labor to build a mosque in the central square. Around each "place publique" are arranged about 20 millet-stalk fenced compounds, each containing several buildings. Most of the buildings are 5-sided grass thatch huts with sand floors, although some compounds have cement walled or floored huts, or an occasional tin roof. Villagers have planted a number of trees to provide shade to the compounds. The government's Department of Eaux and Forets provided nime seedlings a number of years ago, as a result of which each compound in the village has at least one nime, the preferred shade tree. Villagers are experienced in planting and transplanting these trees, and some of the compounds have small "tree parks" to raise seedlings, which are then planted throughout the village.

In N'Dieye Sefour most daily activities in the compound take place outside the huts, which is why shade trees are so important to the villagers. In winter months, however, early mornings and evenings are rather cool (65-70 degrees F.), and villagers warm themselves by gathering in the compound head's sleeping hut, where they sit around a small charcoal stove while water is boiled on the stove for tea. Charcoal is rarely purchased; the women "make" it by snapping off the charred ends of sticks from the cooking fire and burying them in sand. Often they build a small fire in a shallow metal pan partially filled with ashes, feeding in small sticks as they sip the tea which constitutes breakfast for the adults of the compound. Leftovers, usually millet cous-cous, from the previous evening's meal, are generally available for the children; adults usually take a morning meal only during the rainy season, when they will be working hard in the fields all day. Because the interiors of the small thatch huts are dark, a kerosene lamp is often lit to provide light for the tea preparation, and for morning prayers in this Moslem village.

Millet is the staple food in N'Dieye Sefour, and it is usually cooked by steaming in a perforated clay or metal bowl set over water or a sauce, boiling in a large iron pot. The millet has been dried for several weeks in the fields after harvest, and then chopped with spades as it is packed into round woven-branch,

thatch-roofed granaries set on stilts above the ground. The women must pound the millet for several hours in a large wooden mortar, first to dehull it and separate the chaff, and then to grind it fine enough for steaming. According to the village women, this task of pounding millet with a heavy wooden pestle is the cause of innumerable aches, pains, blisters and soreness, as well as being extremely time-consuming. The village women, aware that many communities in Senegal have diesel-powered millet grinders, expressed strong interest in obtaining one for N'Dieye Sefour. In March, a local officer of Promotion Humaine formed a women's group of 250 women, from 7 villages include N'Dieye Sefour. A millet-grinder was purchased with money form the U.S.A., and the women collected funds to build a cement building for the grinder. By the end of April, most women in the village were using the grinder, which costs 7.5 CFA per kg. of millet ground. The women must still pound the grain to thresh it, but the time they spend is greatly reduced.

One method used by the women to cope with the demands of wood-gathering, water carrying, grinding, and cooking, all of which are both exhausting and time-consuming, is to rotate cooking responsibilities within the compound. In most cases, the head of the compound's wives, daughters, sisters, sisters-in-law, etc., cook for two days each.

As for the men, there are few opportunities for gainful employment in the village other than farming and animal husbandry; leaving N'Dieye Sefour for the cities to find work is the accepted practice when cash is necessary. A good deal of the villagers' cash income comes from relatives in the cities. There is very little preparation for the coming growing season, until the fields are cleared in May and June. Throughout the year, the cows, goats and sheep are tethered at night to posts stuck in the fields. The posts are moved weekly, so that animals' manure is distributed throughout the agricultural land. Manure from horses, which are generally kept inside the compounds at night and fed peanut hay, is raked into piles and carried out to the fields in 2-wheeled horse carts before planting begins. Although N'Dieye Sefour is an ONCAD center (the national peanut cooperative) for 17 villages, only a few of the villagers use the commercial fertilizer available on credit from ONCAD. Fungicide and seed peanuts are bought on credit, as the farmers' own crops are often too poor to use for seed; the debt is paid back in peanuts, at an interest of 25%, after harvest.

Because N'Dieye Sefour has no market, the villagers go into Kebemer for the regular Monday market there. Those families who own a horse-cart (25-40%) go each Monday, usually transporting at least one person from every compound in the village. The relatively close contact with a town the size of Kebemer seems to have raised the expectations of the villagers in N'Dieye Sefour. They usually purchase kerosene for their lamps in the town (buying

kerosene in a small village boutique means paying 125 CFA per liter instead of the 100 CFA price in Kebemer), but a number of villagers expressed a preference for electric lighting "like Kebemer" when questioned by the survey team. Although the villagers in Quartier 2 recently collected money for repairs to their well, a number of families told the surveyors that they felt their water had "microbes" that might make them ill, and that water from faucets, pumped from deep bore wells, would be much better for them. One "wealthy" man in the village (not among the sample) has recently purchased a propane gas stove, prompting the other villagers to want the same, in order to elimiate the endless search for firewood. Finally, most households have either a radio or a tape player, but complain that they haven't enough cash to buy batteries to operate them. When batteries are too old to operate the radios they are used in flashlights, to light the huts or for walking around the village when there is no moonlight.

The villagers of N'Dieye Sefour consider their area to be fairly windy, being close enough to the ocean to receive a moderate to fresh breeze every afternoon. During the rainy season, the wind reaches gale force occasionally, knocking over huts and millet-stalk fencing. A simple wind machine might provide considerable help to the village for water pumping; if sufficient water were available, the villagers could apply their past experience in raising seedlings to care for a community woodlot. Already, a small plot of eucalyptus seedlings planted in August are being cared for enthusiastically (eucalyptus is new to the area, and is highly prized for its medicinal properties).

The year-end survey report includes information on a major change in fuel use patterns for N'Dieye Sefour. As part of the investigation of domestic energy use, the team weighed firewood and other fuels in eight households in the village, to determine one day's consumption of fuels for each household. The measurements were done approximately every two weeks for the first three months of the survey year, and then once a month thereafter, by weighing a quantity of wood one night and then weighing what wood remained the next evening, the difference being recorded as one day's consumption. A wood-conserving stove building demonstration was held in July, 1980. The villagers were apparently very receptive to the Lorena stove concept, and as a result, all seven of the households in the survey sample built and began cooking with stoves instead of open woodfires (an eighth household in the sample moved from the village before the demonstration). The fuel measurement records for these households show a considerable reduction in the amount of firewood used during the last five months of the survey. In fact, they show consumption almost halved for most of the households, although adjustments for seasonal and other factors would probably make the figures closer to a 30-40% reduction, the estimate of the Peace Corps Volunteer on the survey team.

Even more than the fuel measurement records, the comments in the narrative part of the survey report attest to the success of the Lorena stoves in this village:

> August, 1980: "July 10 - held a stove stage in N'Dieye Sefour. By July 22 there were over 100 stoves in use/awaiting drying. Nearly every cooking hut has a stove and they are used for all meals regardless of pot diameter. The villagers chose the simple chimneyless model. Women did 90% of the work (clay is not immediately available) even though it was Ramadan and they were fasting."
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> December, 1980: "Over 90% of the women have been using their stoves for the past five months - they do not use them for their breakfast, as the large pot which fits the stove is not used. They like the stove for a number of reasons: 1) economizes wood (saving them time - they do not worry about long term effect of their wood consumption habits on the countryside); 2) children cannot burn themselves accidentally on the cooking fire in the stove; 3) they do not have to worry about an occasional gust of wind throwing a spark from the cooking fire and igniting the grass hut and possibly the whole compound or village - the stove contains the fire; 4) the errant goat cannot overturn their pot when it is in the stove; and 5) the stove greatly reduces the time required to cook the meal, as the contained heat in the stove is hotter and cooks faster.
>
> They recognize wood scarcity as a problem but they see the stove as a convenience and they are not really interested in using the stove as efficiently as possible (if it means more work, i.e. cutting the wood into small pieces to fit properly in the stove, covering the stove door, etc.).
>
> The women use the stoves for lunch and dinner and they claim that the wood they would use for lunch on an open fire will now cook lunch and dinner in the stove. Their estimate is probably a little high - but the stove does seem to save consistently over 30-40%."

Bokhol

Bokhol is a farming community on the Senegal River in the far north of the country, on the border with Mauritania. The village has between 1000 and 5000 residents, and is built between the river bank and a state highway on gradually rising land. A few trees are planted around the village and along the highway, and thorn bushes and scrub trees are scattered around the area, between the villagers' agricultural fields.

Bokhol is the site of the Senegalese government agricultural project, the SAED, which operates a tomato cannery and promotes raising of tomatoes. Ninety-five percent of the villagers of Bokhol are tenant farmers for the SAED, raising tomatoes as a cash crop. The tomatoes are sold to a cannery at 10¢/kg., providing the main income for the community. The other main crop is rice, grown for comsumption; some rice is sold by the village women at the two small daily markets in Bokhol, or in the major area market in Dagana, 10 kilometers away, for money to buy fish and vegetables.

Some quantity of millet is also grown for consumption. The villagers of Bokhol generally eat their main meal at noon, and in the sample families the noon meal is almost always rice, eaten with fish and vegetables in a sauce. Millet is prepared for the evening meal, also with fish and/or vegetables; the leftover millet is often eaten the next morning, either with a sauce or as a porridge with milk. Rice is definitely the preferred grain, and is eaten both at noon and at night if the family can afford it. It is unclear whether rice is preferred primarily as a matter of taste or because its preparation is easier, requiring only one-half the time and effort of millet to pound (dehull) with a heavy mortar and pestle.

The SAED has a farmers' cooperative which provides fertilizer (urea and 10-10-20- "glace"), herbicide and pesticide with pump sprayers, and water for irrigation. The water is pumped into a central canal, and then into tributary canals leading to individual fields. All of these supplies and services are supplied to the tenant farmers on credit. One farmer interviewed by the survey team expressed a dissatisfaction with the situation, a feeling which the survey team asserts is shared "by a majority of the villagers." The main complaint was that after the sale of the harvest, paying back the co-op for credit extended does not leave enough money to live on. This particular farmer is a member of the SAED co-op but does not farm for the project. Instead, he raises millet for his own family and for sale in the village. For the Co-op project, he "hires" a Peuhl, a member of a traditionally nomadic, herding tribe. The Peuhl man farms the SAED land and shares the profits with the millet farmer. Last year's share for the millet farmer was five sacks of unhulled rice, which he said

would not last his family through the year.

The SAED farmers work 8 - 9 months a year for the co-op. There is a sugar factory "nearby" Bokhol, where some villagers work. A few residents work as drivers in towns and cities in the area; there are 3 taxis and a truck based in the village itself.

As for fuel consumption, there is a diesel-powered rice-huller and millet-grinder, for which those who can afford it pay U.S. 10¢/kg. to have their grains ground. There is also a diesel generator which provides lighting for the mosque area, and electricity for an occasional cinema. The generator was paid for by a village organization which collected money from the villagers; other projects sponsored include a boxing tournament, a storage facility for drugs for the village infirmary, and the building of a telephone booth.

The main cooking fuel is firewood, which is collected from two wooded areas approximately five kilometers from the village, and one area ten kilometers away. Because the distances traveled to find wood are so great, some of the villagers either hire a horse cart and driver to gather wood for them, a cart load at a time (U.S. $5 to $5.50), or buy wood from the cart owners in small bundles (approximately 6 pieces/25¢). One of the advantages of using carts to haul wood, instead of the traditional woman-power, is that large sections of tree trunks can be brought back to the compounds. When the women and children forage for wood, they usually gather small dead tree branches, bushes or sticks, which burn fast in the open cooking fires; the longer-burning trunk sections are more efficient, although they must be split to fit on the fires (whether cooking inside a mud-brick, thatch-roofed cookhouse, or in an outside area next to a storage building wall or other windbreak, the Bokhol women usually build their cooking fires in a shallow metal pan, and place their pots on a metal tripod or a three-stone arrangement over the flames).

Charcoal is used for making tea and coffee throughout the year. In the cool mornings and evenings of January and February, it is also burned to provide heat for the villagers' houses. The small "furneaux" or metal charcoal stoves used for boiling tea water are carried into the sleeping rooms, or more commonly, a bowl half-filled with ashes is placed in the center of the room, and charcoal from the furneaux laid on top of the ashes.

Another reason for increased use of charcoal during January and February is the need to heat bathing water. Most of the villagers are Moslems, and they feel it important to bathe before prayers. A pot of water is heated on the furneau after morning tea has been prepared (and occasionally at other times of the day) and added to a large basin of cold water stored in the "shower area", a fenced or sheltered area of the compound used for bathing and urinating.

In January of 1980, there was almost no charcoal in Bokhol; the farmers were still busy in the SAED fields or in their personal fields, so that no one had time to go to the forests to gather wood to make more charcoal. The only charcoal use measured by the survey team at that time was a very small amount used for making tea. Later in the spring, charcoal was once more available for sale in the village. Over the course of the year, the price rose from U.S. $2.50 to $3.00 per bag.

Kerosene lamps are used by the villagers for light in the evenings. The Kerosene is sold in Bokhol; in early 1980, the price was U.S. 40¢/liter, and by the end of the year had risen to U.S. 50¢. The buying of firewood, charcoal, and kerosene for lighting takes less than an hour a day in most Bokhol households, and while it is often the women who carry out these transactions, the young men and boys sometimes share in this work. The women do, however, have full responsibility for collecting and transporting the family's or compound's water supply. The water sources for the village are the Senegal River, and six-13 meter wells. Families living closest to the river are likely to rely on it for the major part of their water, whereas compounds farther from the river rely primarily on wells. Each May through July, however, the entire village must use the well water, as the Senegal River becomes too salty for use. Some of the wells run out of water occasionally during this dry season, but they are all usable year-round.

Most village families keep two to five sheep in their compounds, feeding them leftovers and the rice hulls and debris from the daily pounding of rice for meals. Their dung is not used as fertilizer in Bokhol, probably because of the availability of commercial fertilizer through the SAED.

There was only one light rain between January and August, 1980. It rained steadily for three days in August and September had 3 hard but brief rainstorms, accompanied by winds of approximately 20 mph. Otherwise the village and 10-12 hours of sun each day.

Mbaye Faye Mamadi

Mbaye Faye Mamadi is an agricultural and dairy-farming village of less than 1000 people in the southern part of Senegal. The village land and surrounding area is very flat savannah, with a small valley or depression (10-15 meters deep) to the south of the village, running east and west.

Throughout most of the year, the climate of Mbaye Faye Mamadi is warm and sunny. During the survey period, January through December, 1980, the rainy season arrived a little later than expected, with clouds gathering in late June but only two light rains fell before July. From July through September, there were about ten heavy rains and clouds four to six days a week, gradually disappearing until, by October, the skies were clear and sunny once more.

Close to 100% of the villagers farm the lands around the village during the agricultural season, June through December, growing millet, sorghum and corn for their own consumption and peanuts as a cash crop. The peanuts are sold immediately after harvest to ONCAD, the national peanut cooperative (and the only sales outlet for peanuts in the country), which has a branch in Mbaye Faye Mamadi. The villagers also raise a small quantity of squash, sweet potatoes and tomatoes, usually in small plots next to their compounds.

About thirty percent of the villagers are herders, caring for about 350 dairy cattle. Many more of the villagers are involved in the dairy cattle business, through their practice of "loaning" cows. In loaning a villager buys one or more cows and gives them over to the herder to care for. The herder gets all the cow's milk, which he sells, and he keeps some share of the cow's offspring, usually one out of every three calves born. Some of the herders actually own none of their cows outright; there are three herds of 60-100 cows made up of loaners. Villagers also raise other livestock, including more than 200 sheep and goats, 50 horses, 25 donkeys and several hundred chickens.

The village compounds in Mbaye Faye Mamadi are surrounded by millet-stalk fences. Inside most compounds are several mudbrick, thatch-roofed sleeping huts, mudbrick or raised woven-wood storehouses, at least one mudbrick cooking hut, and one or two thatch-roofed animal shelters. Many compounds contain more than one household. The arrangement may consist of extended families of several generations, with brothers, sons and cousins and their wives and children, or simply of two or three families sharing a large enclosure. Three of the ten households in the survey sample shared compounds with other families; partial walls of millet-stalk are built between households and around sleeping huts and bathing areas to provide privacy. The vegetable gardens inside or

next to the compound walls often have fences made of thorn bushes, which offer more discouragement to foraging animals than the millet fences.

A few villagers have cement houses with tin roofs, or even tin-walled cookhouses, and one family included in the survey sample has a latrine within the compound. Most of the houses, however, are built of local materials which do not stand up well against the summer rains and the strong winds which sometimes accompany them. After the crops are harvested and stored, the ever-present repairing of thatch or mudbrick occupies much of the villagers' time. A laborer can sometimes receive 250-500 CFA per day for this work. More often, though, the work is done by the householder, or with help from neighbors which he will repay in kind.

Likewise, the villagers do very little pooling of money for cooperative projects, as is done in some wealthier villages. Instead, they pool labor for such projects as road improvement and repair to the mosque and the village wells. They donated a small amount of money, as well as labor, for a village pharmacy project which opened in the 3rd quarter of the survey year, staffed by a health worker trained in the regional capital. A new well was dug in the spring of 1980, bringing the total in the village to four cement-lined wells approximately 30 meters deep.

As is true in many Senegalese villages, some of the men from Mbaye Faye Mamadi leave the village after harvest to find work in the city. Some villagers, of course, derive income during this period by providing services such as driving taxis (there are three local taxis, not based in Mbaye Faye Mamadi) or mechanical repair, or by making cloth, clay pots, and simple jewelry. Some operate small stores selling kerosene and candles (used throughout the village for lighting) dried fish, soap, rice, etc. The head of one household in the survey sample is a marabout, a religious leader who runs a Koranic school, the only school in the village. Marabouts usually receive donations either of money or of food and goods from the parents of the young boys they instruct in the Koran. They may also have a small practice as healers of simple illnesses.

Millet is the staple food of the Mbaye Faye Mamadi villagers, who usually eat it three times a day - although most prefer to have rice at the noon or evening meal if they can afford it. Millet requires long hours to prepare. While the village has a diesel powered millet grinder, few of the families in the energy survey sample can afford to use it regularly. Instead, the women place the heads of the millet plant, which have been cut off with a knife from the tall stalks in the field, in their deep wooden mortars and pound them over and over with heavy wooden pestles to separate the grains from the stems and remove the hulls. Once the chaff is separated from the grain, the millet is pounded again,

until the grains are broken into tiny pieces. It is then put into a perforated bowl which is set into the rim of a large cooking pot containing a sauce of peanut oil with ground peanuts, and sometimes onion, beans, dried fish and or tomatoes; the millet steams over the boiling sauce. Before it is eaten, boiling water is sprinkled over the millet couscous to "wet it down,' and it is then placed in a large gourd or enameled metal bowl, and the sauce poured over it. One large bowl is prepared for the men of the compound, and another for the women and children, who usually eat after the men or some distance away from them.

Where a compound head has more than one wife, or teenaged daughters, the women generally share the cooking responsibilities by having each woman cook for two days at a time. In the households in the survey sample, women spend an hour each morning and 2 to 3 hours at noon and in the evening cooking meals.

Wood for the open cooking fires (pots sit on three rocks over the fire) is collected from the fields surrounding the village during the dry season, and from farther away when the near fields are under cultivation. This task is the responsibility of the women, who spend an average of 1½ hours a day collecting wood. In some households the woman whose turn it is to cook gathers the wood for that day or two days, and in other households all the women go to the fields together, taking their children with them. During the dry season the distance traveled to gather wood is around two to three kilometers. When the fields are not under cultivation they produce a lot of scrub trees and small bushes, which the women cut down and leave there "in the bush" to dry. They pick up any dead, fallen branches, and the bushes and branches which were cut a few days ago and are now dried enough for burning. The wood is carried back to the village on the heads of the women and added to the woodpile in the compound. Most families do not maintain a large stockpile of wood although they make an effort to bring in a lot of wood before the rainy season, when the farmers are cutting all the scrub in order to prepare the land for cultivation.

There is one ethnic group, the cattle herders, comprising one-third of the village, which uses dung as a cooking fuel. Their women gather dung from the area where the dairy cows are tethered at night. Apparently dung is not an acceptable cooking fuel for the rest of the village, although the villagers use dung as a fertilizer for their agricultural fields.

While firewood is not generally sold in Mbaye Faye Mamadi, villagers occasionally collect large amounts of wood and take it by horse-cart to neighboring villages to sell. Charcoal is occasionally sold in the village, but is also more commonly taken to other villages (The survey team had difficulty in obtaining information about charcoal production and marketing, as much of it is illegal). Villagers also make small amounts of charcoal from

their cooking fires, burning it in small braziers to make tea.

Kerosene lamps are used for lighting in the village houses. Most families use only one or two lamps, and purchase the kerosene in small amounts from small shops in the village or from the market towns nearby. As Mbaye Faye Mamadi has no regular market, there is frequent travel to a daily market in a village 5 kilometers away, or to larger markets ten and twenty-five kilometers distant. During the rainy season of 1980 there were periods when the local boutiques had no kerosene, due to a cash shortage on the part of shop owners, and to increased prices for kerosene.

The four village wells are fitted with ropes and pulleys. The village women draw up water in rubber pouches attached to the rope, and carry the water to their compounds in basins and buckets. In all but one of the ten households surveyed, the women spend two hours each day lifting and carrying water; the household reporting only one hour a day spent at this task keeps few animals and thus requires less water. Six of the ten households filter their water for drinking, pouring it through a cloth before storing it in large clay pots.

Farming activites begin in May and June, with the clearing and preparation of the fields. Before planting their peanuts, millet and corn, usually done as soon as the rains begin, the farmers spread both natural and commercial fertilizer.

During the first six months of the year the cattle are tethered at night in fields which become cropland with the arrival of the rains, so that the cow dung is spread "naturally" over the land. (After the agricultural season has begun, the cows are herded into the bush and kept away from the growing plants and harvested crops drying in the fields.) Families with horses usually keep them inside their compounds; the horse manure is raked daily into a pile, which is carried to the fields and spread before planting.

As the ONCAD credit system provides commercial fertilizer 7-14-7, most farmers use that on the peanut fields. At 1250 CFA for a 50 kg. sack, however, few farmers can afford the customary 3 sacks per hectare for all their fields. Some farmers merely spread the commercial fertilizer more thinly than suggested, but most farmers rely on dung as the only fertilizer for certain crops. ONCAD provides seed peanuts and seed grain on credit to farmers, too. During May and June, the markets in nearby towns were closed to prevent villagers form selling the seed grain as food, which is often in short supply by that time of year.

Planting, weeding and harvesting are usually done by the farmers' families, although village youths sometimes hire out as field workers for 200 CFA per day. The peanut crop is sold to ONCAD, and the other crops sun dried for 2 or 3 weeks and stored within the household compounds.

Manecounda

Manecounda is a village of less than 500 people, near the seacoast in the southern Casamance region of Senegal. The village compounds are built in six clusters, with palms and fruit trees scattered between. A laterite road separates the six "habitations" from the bank of a river. The surrounding area contains both flat plains and low rolling hills. In the fields around the village grow "plentiful" scrub trees, bushes and grasses. There are forested areas within 3 kilometers of the village in 3 directions.

During the first half of the energy survey year the days were almost always sunny, with 12 hours of sun per day. There were five brief showers in June, and then the rainy season arrived in force, with heavy rains in the mornings and evenings in July, August and September. Temperatures range from 60 degrees Fahrenheit in the early morning to 95-100 degrees at noon, with very little change throughout the year. There is very little wind (most days less than 12 mph) except during the rainy season, when winds of 25 mph and more are not uncommon.

During the growing season (June - July to December) almost all of the villagers of Manecounda engage in farming. The major cash crop of the village is peanuts, which are sold to the national peanut cooperative, ONCAD. For their own consumption, the villagers grow millet, corn, rice and sorghum, as well as mangoes, oranges, grapefruit, lemons and bananas.

In addition to farming, most villagers work at fishing and shrimping in the river. Traditional dugout canoes, some with outboard motors, are used for fishing; the men either cast nets and then draw them back into the canoe, or wade in the water to pull in nets laid out by the boats.

Selling shrimp and fish, citrus fruit, bananas and mangoes provides extra income for many of the villagers in Manecounda. One household in the sample derived its only income during the spring from selling palm wine. Another household head worked for six months as a government (ONCAD) agent, weighing peanuts.

The villagers of Manecounda have not engaged in any village-level collective projects, but the peanut farmers all belong to ONCAD, the Senegal peanut cooperative which is the only market for their major crop. In addition to purchasing peanuts, ONCAD extends credit to farmers for buying fertilizer, seed peanuts and fungicide.

All the households in the survey sample live in mudbrick houses, with the exception of one family whose compound had been destroyed by fire. They erected temporary round huts of woven

bamboo matting, with roofs of leaves and branches, while rebuilding. There are two styles of houses represented: traditional round one-room huts with thatched roofs, and rectangular multi-roomed houses, usually with tin roofs which overhang the walls, resting on posts between which hang bamboo mat screens, creating an enclosed verandah around the house.

During the dry season, making mudbricks for construction and repair of these houses provides one of the few opportunities for employment in Manecounda.

Besides sleeping rooms, each compound contains other buildings used for cooking and for grain storage. In households where the household head has more than one wife, there is usually a cooking hut for each wife. It is customary for a man to provide his new wife with a complete cooking facility as part of the marriage settlement, with the result that many of the sample households contain three or more identical cooking huts, each with its own set of iron cooking pots, gourd bowls, long-handled spoons and wooden stirrers, and three smooth rocks on which to place the pots over the open wood fire in the center of the hut.

The cooking huts are constructed in one of two ways: either a round structure with woven bamboo walls and a grass thatch roof, with an elevated shelf inside for storage of utensils and food, or a low round mudbrick house with a "second story," a woven bamboo granary, sitting on top of it. In the second design, the burning of cooking fires below the granary helps to dry out the grain and to keep away insects and rodents. Other grain storage buildings are either mudbrick or elevated bamboo matting huts with the same round shape and thatched roofs. Most compounds also have a raised drying platform, on which fish and grains can be sun-dried in the open air.

The only source of water in Manecounda are hand-dug wells, most of which are around 11 meters deep. The shallowest well in the village is five meters deep. The women of each household spend one to three hours daily drawing water from the wells and carrying it back to ther compounds in buckets and basins . The villagers seem generally content with the quality of their well water, except for complaints about "things falling into the well." Pigs are apparently the worst offenders. During the driest months, April - June, the water level in the wells is very low, and the usually "crystal-clear" water becomes murky and, occasionaly worm-infested. Water used for bathing and washing is stored in clay basins holding about 10 liters each, while drinking water is poured from 15 liter round-bottomed, narrow-necked pots which are kept in the living and cooking huts.

There are only two fuels used routinely by the villagers of Manecounda - firewood, for cooking, and kerosene, for lighting. Those fishermen with outboard motors for their canoes use

gasoline, which must be purchased in a town 28 kilometers away. Charcoal, which is used in quantity in some Senegalese villages, is apparently not available in Manecounda, and there is no charcoal use reported by the energy survey team.

Firewood is collected daily by the village women, from the fields surrounding the village and from wooded areas 1-3 kilometers away. There are several varieties of wood used for cooking fires, including fruit trees and other hardwoods as well as the scrub trees and bushes growing in fallowed fields. The women spend between two and four hours gathering enough wood to cook their two daily meals.

Kerosene is sold in small boutiques in the nearest village to Manecounda, one-half kilometer away. The purchasing of kerosene is not the particular responsibility of the women, but is done by anyone in the household. Kerosene prices rose during 1980, from 110 to 120 CFA per liter. The villagers use their kerosene lamp for light by which to eat their evening meal and to socialize; most of the households in the sample keep at least one lamp lit throughout the night.

The main village-based means of transportation is the animal-drawn cart, or "charrette", although there are a few bicycles (4% of the villagers own one) and one or two mopeds (.5%). As the village has no market, the villagers rely on one of the above methods of travel to transport not only fuel but also goods not available in the village (or, of course, they can carry them on foot). Occasionally, vendors of food and other goods come through Manecounda and the villagers can shop at home.

In addition to collecting firewood and water for the household, the women of the compound spend several hours per day preparing millet and other grains which serve as the staple foods for the villagers of Manecounda. A large, deep wooden mortar is used to hold the grain, which is pounded with a heavy club or pestle to remove the hulls and crack the grains. Periodically, they pour the grain into winnowing baskets and shake it back into the mortar slowly so that the wind can carry away the chaff. Many of the families in Manecounda eat millet at both the mid-day and the evening meal, usually with fish when it is available. Some of the families in the survey sample have rice in the evening, again usually with fish; the only family in the survey which eats a meal in the morning prepared rice for that meal as well. Sorghum and corn may be substituted at an occasional meal.

Manecounda farmers plant their crops as soon as the rains begin, preparing the fields with hand hoes which are also used for weeding. Farming is a family affair; the men and children do most of the field work, and women join in for harvesting and spreading the crops in the sun to dry.

Ouarrack

Ouarrack is a village on the flat sandy plain of Sahel, in the northern part of Senegal. Between 1000 and 5000 people live in this farming community, although many of the men of the village leave Ouarrack for part of the year to find work in the towns and cities of Senegal. After the harvesting of the crops in December, there are few opportunities for employment in Ouarrack until the advent of the next "rainy" season, usually in late June, when the farmers plant their cash crop of peanuts and food crops of millet, beans and watermelon.

The land around Ouarrack is completely flat, with sparse vegetation and very few trees. The soil is "all sand." The villagers consider the area to be windy, although the survey team does not provide information about wind velocity. There were two brief rains during the first quarter of the survey period, which was unusual for the region, but most days were completely sunny, with little or no cloud cover and 12 hours of sunshine. The village is at sea level.

Ouarrack does not have a regular market, although staples such as rice, sugar, coffee and tea are available from small village stores. The villagers occasionally travel to nearby village markets such as Coki, 7 kilometers away, or to the major market town of Louga, which is 22 kilometers from Ouarrack. There are no buses or taxis serving the village, although trucks driving through the village will take passengers, and some of the villagers have horse-drawn carts, or "charrettes." A major means of transportation, however, is the railroad line which passes through Ouarrack. A trip to Louga on the train costs 150 CFA. Even more convenient for the villagers are vendors passing through the village on the train, who sell dried fish and, occasionally, vegetables.

Ouarrack has an ONCAD center (the national peanut marketing cooperative) serving ten area villages. The co-op purchases all peanuts produced by the farmers, and extends credit for fertilizer, fungicide and seed peanuts. The village also has a primary school, a Koranic school and an "alphabetization" program to teach villagers to write Wolof in modern script. There are few skilled tradesmen in the village, except for three blacksmiths and a man who repairs the charrettes. One family in the sample are griots, who receive money from other villagers for dancing, drumming and reciting stories of Ouarrack history.

Most of the compounds in Ouarrack are surrounded by millet-stalk fencing. Inside are traditional pentagonal huts built of millet-stalk walls and sheet metal roofs. One 17-member household in the survey sample has a six-room cement house with a metal roof; this compound also contains a cement storehouse, a shed of

sheet-metal and a sheet metal walled and roofed cookhouse. Most compounds have one or more nime trees to provide shade, although a number of the trees are only recently planted, and still small.

As is the case in many villages in the Sahel, water is in short supply in Ouarrack. Seven cement-lined wells and approximately fifteen unlined wells comprise the entire water supply for this large village; the wells are therefore in use 24 hours a day. It is the responsibility of the women in each compound to draw water for the household's needs and to carry it to the compound. In one of the survey sample households, the two adult women draw water between midnight and 6 AM, transporting the water to their home 30 liters at a time, in metal basins balanced on their heads. (Later in the survey year, the head of this household took another wife and the well near the compound was repaired; as a result, the women now spend only 4 to 5 hours getting water.) Water is drawn not only for drinking, cooking and washing, but also for watering the livestock, which are kept within the compounds at night. The wells are 22-23 meters deep and usable year-round, but the water level is lower each year, and villagers must continually re-dig and clean the wells to assure a sufficient water supply. Drinking water is generally filtered through a cloth as it is poured into clay or cement storage pots.

Firewood is used for most cooking in Ouarrack, although many of the sample families augment their wood supplies by occasionally burning dung in their open cooking fires. Small "hibachi-type" charcoal stoves are used for boiling coffee or tea in the morning, and during the "cold" months of January and February, these stoves are used to heat the sleeping huts. Most families surveyed expressed the desire to use these stoves for heating on a regular basis, but explained that there is simply not enough wood and charcoal to do so; in most cases, therefore, "heating" is really available only while the coffee or tea is being prepared, or at night in the huts of very elderly family members. Rather than burning wood on the sand floor of their cooking huts, most Ouarrack villagers lay their cooking fires in a shallow metal pan (although one sample family has a cement-lined fire-pit in the center of their cookhouse). Once the fire is going, they place a large three-legged pot on the pan. The diet of the Ouarrack villagers consists almost entirely of millet, usually steamed over a boiling sauce so that the entire meal can be cooked in one pot. The evening meal is typically millet cous-cous with a bean or leaf sauce, often with dried fish added to the sauce. Leftover cous-cous is eaten in the morning without reheating. At noon, steamed millet is usually mixed with a yoghurt sauce, making a kind of porridge.

Firewood collecting is the responsibility of the women of the village. In some households, all the women gather wood; in others, both woodgathering and cooking responsibilities alternate among the adult women. Two of the survey families, whose

compounds are adjoining, trade off cooking and woodgathering, and meals are eaten together in one compound for a month and then in the other compound the next month. The heads of these two households are brothers; one works part-time as a tailor in Louga, and the other has a small shop in the compound. The shop-owner and his family are the only villagers in the sample who regularly purchased their firewood in the first half of the year, instead of collecting it, buying an average of two 8kg. bundles every other day at 60 CFA/bundle.

All other families gathered wood during this time, usually fallen tree branches, thorn bushes and scrub trees. The women spend more than two hours daily (or four hours every other day) collecting wood. They roam the fields surrounding Ouarrack, gathering both wood and dung from the sheep and goats which graze in the fields during the day, under the care of a shepherd.

There are no forests nearby, and the Government of Senegal has made it illegal to cut down any of the few trees which grow in the Sahelian plain, so the women must spend more time each year searching for wood sources. The villagers are concerned about the scarcity of firewood; their concern is expressed in terms of time because wood is scarce, it takes longer and longer to find it, and the women of the village, with all their other time-consuming responsibilities (water-carrying, grinding millet and rice, cooking) simply cannot spend all of their time looking for wood. Half of the households in the survey sample resorted to buying charrette-loads of wood in the second half of 1980. The wood is brought in from other villages and sold for 1500-2500 CFA per load.

By contrast, it is not particularly difficult for the villagers to obtain kerosene, which, along with flashlights for walking around at night, provides lighting for the village. The small stores in the village sell kerosene by the quarter-liter, and most families only burn their kerosene lamps for a few hours in the evenings. But the cost of kerosene rose during the first quarter of the survey period from 120 CFA to 140 CFA per liter, or from 30 to 35 CFA/¼liter. This period, January - March, is also the period of heaviest kerosene use, as days are shorter and nights colder, causing villagers to do their evening socializing inside the dark sleeping huts instead of outside in the compounds where lamps are seldom needed. There was a brief shortage of kerosene in Ouarrack in September, 1980, because the trains were not running. Trips to Louga were curtailed, as the price for riding a truck to town was 400 CFA, as opposed to the 150 CFA train fare. Train service was restored in October.

Despite the rising costs of kerosene and other petroleum-based fuels, there was considerable interest among the women of Ouarrack in buying a diesel-fueled millet grinder for the village. The daily task of threshing and pounding the day's supply of millet is

both time-consuming and extremely tiring - most women must spend between 2 and 4 hours per day pounding the grain with a heavy wooden pestle to de-hull it and break the millet grains into tiny pieces for steaming. In addition to millet, the women ocasionally pound peanuts to extract the oil which is used in cooking.

The fact that many Senegalese villages now have diesel grinders had not escaped the notice of the Ouarrack women, who spoke to the energy surveyors in January about their hopes of organizing a women's group to obtain such a grinder for their own village. In July, Ouarrack did get a millet-grinder, and the women formed a cooperative group of 160 members, who contributed money for a building in the center of the village to house the machine. By September, most of the women were using the grinder.

Information about farming practices in Ouarrack was gathered by the survey team through interviews with 3 farmers, who each described their farming techniques for a particular crop. The crops chosen are the major ones of the village, and indeed, of the entire country of Senegal: peanuts, millet, and beans. No commercial fuels are used in farming in this village; the advent of the planting season affects fuel use by the villagers to a very small degree. The ever-present problem of firewood scarcity is exacerbated by the fact that many of the fields from which the village women gather brush are cleared and planted in June, forcing the wood-collectors to range further away in their search. Initially, of course, the process of clearing the land for planting yields a large supply of bushes and scrub trees, which can be stored in the compounds and kept dry during the seasonal rains. After this supply is gone, however, the women must resume their endless quest.

After chopping the ground with a hoe-like tool called a "goop" to uproot the underbrush, grasses and agricultural debris from the last year's crop, the material is raked into piles and burned. The ashes are then spread over the fields with rakes, to mix with the dung left by sheep and goats which occupied the fields during the winter and spring. Those farmers who keep horses in their compounds, and who have raked the horse manure into piles by the compound during the previous year, haul the manure to their fields in charettes and spread it over as much of their land as possible. Individual farmers may choose to concentrate their dung fertilizers on one particular crop or another, as there is rarely enough to cover all the fields; the one farmer interviewed by the survey team who uses horse manure chose to spread it on his peanut fields. He did not use the commercial fertilizer which ONCAD sells (on credit) in most Senegalese villages for use on the peanut crops.

In many cases, the entire family, including children, participate in the preparation of the agricultural lands for planting. The actual planting does not require many people, as it

is done with a horse-drawn seeding machine which digs a furrow, drops the seeds into it, and then covers it again. The same machine can be used for all three crops under cultivation, by changing the rate at which seeds are deposited into the furrow, and therefore the spacing of the plants.

Before the seed peanuts are planted they are dusted with a fungicide provided by ONCAD to prevent rotting. No use of commercial pesticides is reported, but one farmer lays down wetted tree leaves over the rows of beans in his field in order to discourage insects. Weeding is done by hand, daily, using the goop. As the farmer and his family are the only field workers, they spend around twelve hours per week at weeding their fields, which average three hectares in size.

There is no irrigation of cropland in Ouarrack, owing to the shortage of water. The rains of June, July and August (only rarely does it rain after August) are the only source of water for the field crops; in years when there are few rains the natural fertilizers are not well mixed into the sandy soil and the crops are small and dried out.

Harvesting practices vary among crops, most farmers in Ouarrack again use family members as field hands, making crews of only three or four people. The time required for harvesting the various crops differs greatly. Peanut plants are usually dug up by a horse-drawn plow, and left in their rows with the peanuts exposed to the sun to dry for a week or two, after which they are raked into large piles for further drying. It may take three people as long as forty days to harvest a three-hectare peanut field. After the peanuts have dried, the piles are beaten with sticks to knock the nuts from the plants. Dried peanut hay is stored in the compound for fodder for the horses and other livestock, and the peanuts are collected, bagged in burlap and taken to the ONCAD storehouse in the village, where they are weighed and purchased by the cooperative and added to the pile in the open 20 meter x 30 meter shed (partially covered with plastic) to continue drying out. The peanuts are shipped out of Ouarrack in March or April.

Millet, on the other hand, is hand-cut with a knife. The stalks are then piled up in the field and left to dry for about ten days, after which they are hit with rakes to knock off the grain, which is stored in an open thatch granary in the compound (the granary will be roofed before the next rains). Much of the millet is still clumped on the grain-heads when stored, and the real threshing, that is, removal of the hulls from the grain, is done throughout the year by the women, who pound one or two days' supply of grain at a time in their large wooden mortars.

The bean plants are also picked by hand and then left in the field to dry. The beans have usually already begun to dry on the plant before harvest, and the piles of harvested plants are hit

with rakes to make the pods drop off. The pods are stored in granaries similar to those for the millet, and pounded in small amounts throughout the year to remove the beans from their pods.

The major problem encountered by the farmers of Ouarrack, excepting the possibility of drought, is loss of their crops during the drying and storage periods, particularly while the crops are drying in the fields. Birds, insects, rodents and roving sheep and goats eat a great deal of the harvest during that period, although the farmers use scarecrows, the livestock herders try to keep the animals away from the fields, and some people even put out poison for the rodents and insects. Another hazard to the harvest is wind, apparently strong enough at times to blow away peanuts and grain while they are drying. Rare but occasional problems are rains out of season, which cause the crops to rot, and fire, an obvious danger in this dry region. Altogether, these problems cause the loss of 25 to 30% of the yearly harvest.

N'Doga Babacar

The small village of N'Doga Babacar lies in the south-eastern region of Senegal, 38 kilometers from the provincial capital of Tambacounda. It is an area of mostly flat land, with some rolling hills and considerable forestation. There are over fifty varieties of trees growing in the area surrounding the village; "a foret classe, where it is illegal to cut wood, lies about 9 kilometers away, and there are some types of wood that cannot (legally) be cut throughout the region," but most villages in the area are close to large supplies of wood. Besides the trees, the region has many grasses, bushes and stands of bamboo, used by villagers in building their houses, granaries and animal shelters.

While the village of N'Doga Babacar has a population of less than 500 people, there is an influx of migrant farm laborers during the agricultural season (June - December) and every household in the energy survey sample has in its compound at least one house for migrant workers.

During the first quarter of the energy survey, January through March, 1980, the days were sunny (12 hours per day) and gradually warmer, with temperature range of 60° - 90° Fahrenheit in January to 90° - 110° F in March. The survey team reports that the months of April and May are usually the hottest in N'Doga Babacar. A few clouds may be seen at the beginning of this period, gradually increasing until the clouds appear for about two hours every day in early June, heralding the arrival of the seasonal rains of late June, July and August, when it may rain as often as three days a week. Although it seldom rains for longer than an hour at a time, the rainfall is sufficient to make the area "very green" during the rainy season.

The area is not considered windy during the survey's first quarter, most days having only a gentle to moderate breeze (8-18 mph). Two kilometers from N'Doga Babacar there are some hills which reach 60 feet in height.

The cash crop of N'Doga Babacar farmers is peanuts, and the village has a branch of the national peanut marketing and credit cooperative, ONCAD, which serves five other villages in the area as well as N'Doga Babacar itself. Other major crops grown by the villagers are millet, corn and cotton. Peanuts are purchased by ONCAD for 2,500 CFA/50 kg. sack; millet and corn, when sold rather than consumed, bring the same price (5,000 CFA/100 kg. sack). There is no information given in the survey report regarding the marketing of the cotton crop.

About 15% of the village men work as traveling herdsmen. N'Doga Babacar villagers own numerous livestock, including over 1,000 cows, 229 goats, 150 horses and 24 donkeys, as well as

"limitless" chickens. The horses and donkeys provide the major means of transportation in the village, pulling two-wheeled wooden carts to carry both goods and people, or being ridden for personal transportation. The horsecarts are most often used for local transport, but occasionally they travel as far as 80 kilometers on a round trip. As N'Doga Babacar has a newly opened weekly market where villagers can buy "almost everything," the need to travel to Tambacounda (38 km) or Coussanar (28 km) is presumably diminished.

During the dry season, January through June, the villagers engage in several non-farming activities to earn money. Those with horse or donkey-carts may go to the forests to cut firewood, which they sell by the cartload (400-600 CFA). Some make fences of bamboo (500 CFA for a 2m x 4m section) or woven mats for sitting or sleeping (600 CFA each). "Water pullers" collect water from the village wells to sell in the market for watering livestock (65 CFA per animal).

The dry season is also a period of building or repair of houses and other compound buildings. The rate of payment for this work is about 4000 CFA per hut. Houses are constructed of mud, in one of two styles: 1) a circular mud hut with two entrances, one window (sometimes), a mud and dung plastered floor and a roof of bamboo poles and grass thatch; or 2) a rectangular house of mud bricks, often with a cement floor and a sheet metal roof, one or two windows and a wooden door. The latter styled houses are generally used by the compound heads as living quarters or storehouses. Wives, children and migrant laborers most often sleep in the more traditional round huts. Other compound buildings include storehouses or barns for grain and peanut hay, shaded rest areas (thatched roofs on bamboo poles) for both animals and people, and cook-houses. Cookhouses in N'Doga Babacar are round clay-brick buildings, approximately 1½ to 2 meters in diameter. Bamboo poles ring the cookhouse, supporting a conical thatch roof which sits about 20 cm above the wall, to allow smoke from the cooking fires to escape from the building. The fire is built in the middle of the floor; the cook either places a three-legged pot directly over the flame, or uses a metal tripod over the fire to support the cooking pot.

Except for the ONCAD center, there is no organized community association in N'Doga Babacar, but the villagers have undertaken group projects such as building a small hut for a dispensary, and collective peanut fields are farmed occasionally to pay for repairs to the village mosque and the central meeting place. All of the villagers who own animals (almost 95% of the village) contribute money to pay for visits of the regional veterinarian, particularly when there is a village-wide animal disease problem.

The only sources of water in N'Doga Babacar are the three village wells, which are 22-30 meters deep with only about one meter of water at the bottom. One of the wells is cement-lined,

while the other two have walls of dirt. The households surveyed all reported some concern about their water; some complained that it is dirty, although they do not apparently filter or otherwise treat the water to remove the dirt. Many families said that there is simply not enough water in the wells, and that it is tiring and time-consuming to raise it out of the well. The women of the compounds make between 4 and 9 trips to the wells every day, and the process of drawing the water and carrying it back to the home in 30 liter pans balanced on their heads takes most women 5 to 6 hours per day.

Furthermore, one of the wells usually dries up during the dry season, increasing the demand on the other two. The wells are 16 years old, and were under repair during the survey's first quarter.

According to the survey report, the villagers felt that the area around N'Doga Babacar has abundant wood at the present time; villagers are well able to supply their needs for firewood from the fallen trees and branches within a 4 kilometer radius of the village. Unlike many villages in Senegal, where finding and gathering firewood is an increasingly difficult and time-consuming task for village women, N'Doga Babacar does not appear to be immediately concerned about the supply of this major fuel. Moreover, the responsibility for collecting firewood is shared in this village between men and women. Indeed, in most households surveyed, the husband and sons of the family, along with migrant laborers during the growing season, are the primary wood-gatherers. The usual practice is to drive a horse-cart (owned, borrowed or rented) to the forests and haul back large loads at a time. One or two cart-loads a month is a sufficient supply of firewood for most households. The primary woods gathered for cooking are kapok, ironwood, parki, rosewood and combretum nigricana. Wood itself is rarely purchased by N'doga Babacar households in the survey sample, although either use of a cart, or the service of cutting and hauling wood may be paid for.

Lighting is done with kerosene lamps in N'Doga Babacar. Many households reported very little use of lighting, saying that the burning of kerosene lamps inside their huts makes the air too hot; even in this "cool" first quarter of the year, some villagers sleep outside in the compound to keep cool, and almost all meals are eaten in the open air. Most families said that lighting was used primarily for the children to study by, or for child care. One family burns a lamp all night long "for the baby".

Kerosene can be bought in N'Doga Babacar for 140 CFA/liter. If villagers choose to travel to Sinthou Malleme, 11 kilometers away, they can buy kerosene for only 110 CFA/liter.

While the women in N'Doga Babacar do not have to spend long hours searching for firewood, the traditional women's task of

pounding millet and rice with a wooden mortar and pestle still occupies several hours per day in every household. Most village families eat three meals every day, typically rice at the noon meal and millet in the evening and again the next morning (most families also eat some dried fish as seasoning with these meals). Rice and millet must be pounded to remove the hulls, and millet requires a second pounding to prepare it for steaming. The women surveyed all expressed dissatisfaction with both the time and the labor required for pounding grain, but they also reported their expectation that the village would acquire a diesel grain grinder "soon". No information is given as to the availability of diesel fuel in the immediate area, although it can be purchased in Tambacounda, 38 kilometers away; it is also unclear just who might own the grinder.

N'Gueth

The village of N'Gueth is situated in north-central Senegal, a region of flat sandy plains with occasional low rolling hills and shallow depressions eroded by wind and water. Trees and brush are sparse in this savannah area; the most common vegetation around N'Gueth is thorn bushes, grasses and a low, vine-like plant "full of thorns which impregnate the soil."

N'Gueth is a small agricultural community of about four hundred people. Almost everyone in the village farms during the growing season, which begins with the first rains in mid-June. The soil is rather poor for farming, being mostly light, powdery sand, easily eroded by wind. Dust storms are common around N'Gueth, causing considerable inconvenience by knocking over millet-stalk fences, eroding mud-walled houses and withering crops. The usual thirteen hours of sunshine each day during the dry season are sometimes cut short by dust clouds which obscure the sun.

The combination of gradual deforestation, wind erosion and a brief and unreliable rainy season has depleted the topsoil from the fields around N'Gueth, and the peanut and millet crops on which the villagers depend for their income and food supply are often small. The 1979 harvest, as reported to the energy survey team, was quite disappointing. Some farmers buy commercial fertilizer from ONCAD, the Senegalese national peanut marketing cooperative, in an attempt to combat the deteriorating soil conditions, but at 1250 CFA per 50 kg. sack few farmers can afford to apply this fertilizer to all their agricultural land. Horse manure is collected and spread on the fields as well. Horses are usually kept inside the family compounds; their manure is raked into piles throughout the year and taken to the fields by horse-drawn cart in May and June. Nomadic herders keep several hundred cattle outside of the village, and sheep and goats are tethered in the fields at night. A small portion of the cowdung is collected by some of the village women for use as a cooking fuel, but most of it is left on the fields to improve the soil.

The market town of Dahra is 4 kilometers from N'Gueth, on a major highway. N'Gueth villagers buy most of their supplies in Dahra, although the village itself has a small boutique selling staples. The larger markets in Linguere (45 kilometers) and the provincial capital of Diourbel (120 kilometers) are visited by N'Gueth villagers only infrequently.

Dahra also provides the only source of employment in the immediate area. During the first quarter of the survey period some N'Gueth villagers supplemented their income from peanut sales by working on the construction of a peanut warehouse and grain storage building in Dahra. Daily wages for laborers average

approximately 800 CFA. Villagers also sell carloads of firewood they have collected, or small amounts of their millet and other crops, at the Dahra market on occasion. All of the households in the survey sample sold millet, animals and or fruit during the 2nd quarter of the year, when money from last year's harvest was running short. One man also worked as a tailor, and another repaired radios to make money. For regular employment, the village men travel to Senegal's large cities. Even some of the young women of the village work in Dahra, in small shops or as maids, doing the same work, i.e., cleaning, drawing water, etc., that they do in the village.

In N'Gueth itself, the villagers have recently constructed two latrines and well aprons for the two wells serving the village. The labor for these projects was contributed by the villagers, and the money for materials came from the Catholic Relief Service.

Most N'Gueth households consist of more than ten people; the average size of the families in the survey sample is thirteen members, several household heads having more than one wife.

The compounds themselves are fenced with millet stalks, often reinforced with branches from thorn bushes to discourage sheep and goats from eating the millet stalks. Compounds generally contain from three to eight huts for sleeping, a cooking area, at least one enclosure for animals, and designated areas for showering and urinating. The square sleeping huts, or "neegs," have roofs of the traditional grass thatch. There are a few rectangular buildings with concrete or mud-brick walls and tin roofs. During the first quarter of the energy survey period, many households in the survey sample were building new mud-brick houses to replace rain-damaged huts from the previous summer. As there is virtually no rain in the area during the first months of the year, newly constructed houses are often used without any roofs at all until June and the advent of the next rainy season. (Rain generally occurs in this region only between June and September. The one very brief and unseasonable rain which fell during the survey period "barely got the surface of the ground wet.") In the survey's 2nd quarter, a brick latrine was built in the compound of the marabout, who holds a Koranic school to teach the boys and young men about Islam.

The major fuel used by the villagers is firewood, with which they cook food and heat their homes during the cool mornings and evenings of the winter months (December through February). The people of N'Gueth must travel up to 15 kilometers to the south and east of the village to find firewood. A large area between the national highway and a "foret classe," (forest protected by the Senegalese government, in which it is against the law to gather wood) 30 kilometers from N'Gueth is used as a firewood source by people from Dahra and other villages in the area. People even come from as far away as Linguere (45 kms.) to collect wood.

A variety of trees is found in this region (the survey report gives Wolof names only) but the trees are scattered over a very large area, and woodgatherers must search for dead trees or fallen branches among them, as living trees are rarely collected. For this reason, the usual practice for woodgathering is to take two-wheeled horsecarts to the bush and fill them with wood. According to the survey report, it is usually the children who do this.

About half of the compounds in N'Gueth (15-20) own these horse-carts, called "charrettes." They are virtually the only means of transportation available to the villagers other than riding the donkeys and horses themselves. Villagers who collect charrette-loads of wood usually sell the wood to other N'Gueth people, or sell it in Dahra. A charrette-load of wood sells for 500 CFA in N'Gueth and may bring up to 650 CFA in Dahra. The most common unit by which the N'Gueth villagers buy their wood, however, is a "bundle" costing 25 CFA. There are 35-40 bundles in one charette-load of wood; while the survey team found one bundle to weigh about 9.5 kilos, they cautioned that the bundles are not divided by weight so that this is not necessarily a representative weight.

All of the families in the survey sample purchase rather than collect their firewood, usually buying it daily or several times per week. In fact, one household head who works as a radio repair-man in Dahra regularly sells wood to supplement his income, and yet he does not apparently supply his own household. The four women in his compound buy 60 CFA worth of wood per day for cooking fuel. (It is usually the cook who buys the day's wood supply, and in families such as this one where there are several wives, the women often alternate cooking chores every day or two.)

While firewood is purchased, millet stalks and thorn bushes are gathered by individual families in the fields surrounding N'Gueth, for use as kindling and for outdoor bonfires in the evenings. Young boys gather fuel for bonfires in the marabout's compound, and sit around them to study the Koran; this Koranic school is the only educational "facility" in the village. Some families (one out of eight in the survey sample) use cowdung as a supplement to wood in their cooking fires, as mentioned above. These villagers say that they would prefer to burn only wood, but haven't enough money.

Cooking fires are often built outdoors in the compound, or under a roof of thatch supported by wooden poles. One family in the survey sample has a concrete-block fireplace, but most villa-gers cook over open fires on the ground. For heating, small fires are built on the floor of a sleeping hut.

Charcoal is another important fuel to the villagers of N'Gueth, who buy it locally or in Dahra. In the first six months of 1980 the price rose from 20 to 40 CFA/kg. Charcoal is burned in small tin stoves, or "furneaux," used for boiling tea (and

occasionally coffee). Tea drinking is an activity usually enjoyed only by men, who take it after breakfast and often again in the afternoon. While most families use less than one kilo of charcoal per day, the fuel is considered quite important by the villagers, for whom tea drinking is a necessary cultural ritual. Also, while usually only the men of a household sit and drink tea, the tea preparation is often a time of socializing for the entire family, as everyone gathers around the furneau in the household head's neeg for warmth and conversation while the water boils. (A woman or child may stop for a glass of tea and then continue on with her business while the men drink 3 or 4 glasses.)

Kerosene is the fuel most used by N'Gueth villagers for lighting. Much of the daily activity of compound life takes place outdoors, including cooking, eating and socializing. For most of the year, the villagers need to use their kerosene lamps only inside their huts when going to bed, as there is enough light outside, even in the evenings, for their activities. During the winter months, however, the days are short and the mornings and evenings cool; more time is spent indoors during this time, and more kerosene lamps and lanterns are used, for longer periods of time (two to six hours in the survey sample households.) Kerosene is sold by a woman in N'Gueth, but is less expensive in Dahra. The Dahra price rose during the survey period from 95 CFA/liter in January, 1980, to 110 CFA/liter in April of that year. In N'Gueth, the price was 120 CFA/liter in April, but jumped to 175 CFA/liter in July.

In addition to kerosene, many villagers use battery-powered flashlights and candles to provide light. Both are available for sale in Dahra.

In order to prepare their daily diet of millet and rice, served with sauces of leaves, beans or milk, the women of N'Gueth must spend several hours a day grinding the grain to remove the hulls and crush the kernels. Rice is purchased, and does not require grinding, but the millet is either from the family's own crops or is donated by the U.S., Canada and E.E.C., and must be pounded at length using a heavy pestle in a large wooden mortar. Millet grinding is regarded by the women as a particularly difficult and time-consuming chore.

In the first quarter, five of the eight families in the survey sample reported that their women sometimes carried millet into Dahra to have it ground by a diesel grinder there. The charge for using the diesel grinder is 10 CFA per kilo of millet ground. This fee, plus the work of carrying the millet four kilometers and back, were drawbacks to be balanced against the effort of pounding manually; several of the women who reported using the diesel grinder explained that they often sold their machine-ground millet in the Dahra market for cash, and prepare grain for their families' comsumption by hand.

In the second quarter of the survey year, N'Gueth villagers received a diesel powered millet grinder from the Government of Senegal. The villagers collected money for a tin building to house the grinder, and built a fence of millet stalks around it. All of the families in the survey sample used the grinder after it arrived, at a lower price than in Dahra - 7.5 CFA/kg.

Another daily task performed by the village women is fetching water for their households' needs. There are two wells in N'Gueth, one near the mosque in the center of the village and one just outside, in a shallow depression. Both of the wells have clean, plentiful water and are usable year round. None of the households in the survey sample expressed any concern about the potability of the "tasty" water (with the exception of one family which mentioned the possibility of hookworms in the water following a discussion about parasites with a PCV).

Although the wells contain sufficient water for the village year-round, the women must draw the water up from deep in the ground. In one well containing 22 meters of water, the water's surface is 31 meters below ground level, and in the other well the water begins 27 meters down. The women draw up buckets from these depths, and fill metal basins which they carry back to their compounds on their heads. Most compounds have a metal barrel or two for water storage; drinking water is usually kept in clay pots which cool the water through evaporation. Women in most households spend two to three hours a day pulling and carrying water.

The survey report describes general farming practices in N'Gueth through interviews with three farmers. There is no agricultural activity during the early months of the year, as planting cannot begin until the first rain has heralded the "wet" season (usually in June). Farmers may begin to prepare for the expected rains by carting manure to their fields, as described above. One man said that he usually takes about 5 charrette-loads of manure to the fields per day, three times a week for a month, to spread on his six hectares of land. He also buys three sacks of commercial fertilizer, at 1250 CFA/50 kg. sack, to spread on the parts of his fields with the poorest soil. Another farmer surveyed buys 20 sacks of fertilizer and collects around thirty-six loads of manure for his eleven hectares . The third farmer interviewed had no harvest in 1979; he had no money or plans to buy commercial fertilizer in 1980.

After the first rain has fallen, the farmers sow their peanuts with a horse-drawn seeding machine, and plant millet, beans, squash and "bisop" by hand. The wives and children of the farmers usually assist in planting the crops and in periodic weeding, using hoes, rakes and pitchforks. There is no irrigation available and the villagers' crops depend on the rains of June, July and August for moisture.

Harvesting is also likely to be a family affair, with a horse-drawn plow used to turn up the peanut plants while millet and other crops are harvested by hand. Peanut plants are stacked in the fields to dry, and then the stacks are beaten with rakes to shake off the peanuts. Likewise, the millet heads cut from the stalks with a knife are piled up in the fields, and surrounded with a fence made from millet stalks to discourage rodents and foraging animals. Beans and squash are bagged and stored inside the compound.

Loul Sessene

Loul Sessene is a village of between 1000 and 5000 people, in the Sine Saloum Region of Senegal, near the seacoast. The area to the east and north of the village is flat savannah, with a "fair" amount of trees, mostly mango, baobab and nime, within two to four kilometers of the village center. Towards the sea there are many low-lying fields used for rice cultivation during the rainy season. Palm trees and thick brush grow near the rice fields. Beyond these low fields are barren salt flats stretching to the sea.

Loul Sessene itself is about 30 feet above sea level, a cluster of millet fenced compounds each containing a few baobab or nime trees to provide shade for the household. A government reforestation project established a eucalyptus plantation at Loul Sessene some time ago. Unfortunately, most of the eucalyptus trees have died, due apparently to a misunderstanding on the part of the villagers as to the purpose of the project. According to the survey report, the villagers thought that the eucalyptus plantation would attract rain to the area; as it failed to do so, the villagers refused to accept responsibility for watering the young trees, holding that the government had brought the project to Loul Sessene and should therefore either water the trees or pay the villagers to do so. Another government program planted trees within the village itself; this "one woman, one tree" program has apparently been more successful, in that the trees survived.

The major crops grown by the farmers of Loul Sessene are peanuts, millet and manioc (and, presumably, rice, although it is not mentioned in the survey narrative). Almost all of the villagers farm the fields around the village during the agricultural season, which extends from the arrival of the rains in June to the completion of harvesting in November and December. In addition to the cultivation of field crops, the village women have created a communal garden, and the three primary schools in the village have a ¼ hectare school garden plot. There is a small diesel-powered forage pump which is operated approximately one hour per day to irrigate a small garden experiment, but the school garden is watered by students who draw water from one of the village wells.

Aside from farming there are very few opportunities for employment in Loul Sessene. Some of the women supplement their families' incomes by selling millet beer, tobacco or kola nuts, bringing in 300-400 CFA per month; the wife in one sample household works as a seamstress earning about 500 CFA per month.

The village has a small boutique selling staples, including the kerosene and candles used by most villagers for lighting, but there is no regular market in the village. N'Goye, three kilometers from Loul Sessene, is the major market village for the

local arrondissement, or administrative region, and villagers walk or ride on horse-drawn carts to N'Goye to do their marketing.

Everyone in Loul Sessene uses water from the village wells, which are between five and seven meters deep. There are both earth-lined and cement-lined wells serving the village, and although some go dry during the dry season, the number of wells is apparently sufficient to supply the entire village without creating concern about the women who fetch the water for their families. In most households surveyed, the women spend two to three hours daily drawing water from the wells in rubber pouches or tin cans lowered on ropes, and carrying it to their compounds where it is stored in clay pots. A few families in the sample filter their water for drinking. The men in the village are building a watering trough near the diesel-powered forage pump, to provide water for the livestock.

The most important fuel to the villagers of Loul Sessene, as in most villages in Senegal, is firewood. As noted above, there are several varieties of trees growing in the area around the village, notably mango, palm, baobab, nime and eucalyptus. Dead branches or trunks from these trees, along with scrub trees, thorn and other bushes provide fuel for the cooking fires of Loul Sessene. The woodfires are also used for heating bath water during the months of January and February, when evening and early morning temperatures drop to around 70 degrees Fahrenheit.

Woodgathering is the responsibility of the women of the village; in each sample household in the survey, the wife gathers all wood for the family's use. In Loul Sessene it is not a daily task. Most women gather wood every three to five days, laying in a sufficient supply to cook three meals of millet and rice each day. (The computable part ot the Energy Survey indicates 3-4 hours/day required for woodgathering, but the narrative quite clearly states that the women do not collect wood daily.)

The survey team reports that wood consumption was high during the first quarter of the year due both to the practice of heating water for bathing over the cooking fire after the meal is prepared, and to the strong winds during this period, which fanned the flames of the fires and caused wood to burn faster. Most cooking in the households of Loul Sessene is done outdoors in the compound; while most compounds have either a millet-stalk cooking hut or a designated cooking area inside a mud-brick house, these areas are used mainly in the rainy season or when the wind is very strong. In the dry season, therefore, the fires under the large three-legged cooking pots are open to the breeze.

The villagers who drink tea or coffee use charcoal, burned in a small metal stove, to prepare their beverages. Charcoal is sold in 1½ meter x ½ meter sacks, for approximately $2.50. Only one family surveyed uses charcoal on a regular basis, and they buy a

sack every 15 days from a neighboring village. This family owns the village boutique, and probably has a higher cash income than other villagers.

Kerosene is sold in the boutique for 50 CFA/liter. All of the families in the survey sample use kerosene for lighting except one household, where the surveyors were told that kerosene was too expensive and the family makes do with light from their cooking fire. Lighting is used mainly in the evenings, for socializing and for children's study. Many villagers own flashlights for use when walking around at night. One family reported that their son milked their cows at night by flashlight. Batteries for the flashlights and for radios constitute the only electricity in the village; no information is given about where the batteries are purchased. For additional lighting, candles are bought from the village boutique. Use of candles and batteries was not measured by the survey team.

Diesel fuel for the forage pump is the only other major fuel in use in the village. Very little fuel is used, as the pump only runs an hour per day. The diesel fuel is purchased 30 kilometers away from Loul Sessene, for 96 CFA per liter.

The villagers of Loul Sessene keep many animals, including close to 1000 cows and about 350 horses and donkeys. The cows are herded in the daytime and tethered in the fields at night, moving from field to field regularly so that their dung is spread widely as fertilizer for the soil.

Sheep (253), goats (183), and donkeys also graze in the fields by day, while horses are fed peanut hay, and the 350 pigs are fed millet hulls. Horses, sheep and goats are penned at night, either in the compounds or nearby. Manure from the horses is collected year-round; in May and June, the horse manure is carted to the growing fields and spread over the ground.

The survey team provides information from three farmers about their agricultural practices for growing millet and peanuts, although, of course, there was no farming of these crops during the first quarter of the survey period. Two of these farmers use a commercial fertilizer as well as the animal dung; the commercial fertilizer is purchased from the national peanut cooperative, ONCAD, which has a branch in Loul Sessene, at a cost of 1250 CFA/50 kg. sack. Two of the farmers interviewed also use fungicide from ONCAD on their peanuts, to prevent rot.

The farmers and their sons clear the land with hoes called "helaars," spread manure and other fertilizer by hand, and plant their crops using a horse-drawn seeder/cultivator which turns a furrow, deposits seeds, and covers the seeds with earth. One farmer in the sample rents the machine, the others presumably own theirs. Some farmers use the same machines for weeding and for

harvesting the crops; the entire process is done by hand using the helaars in areas where the machines cannot go, or when the farmer cannot afford to rent a machine.

As is the practice in most of Senegal, the harvested crops are left in the field to dry for a week or so; the peanuts are then threshed by hitting piles of plants with sticks to knock the peanuts off, while the millet is stored in woven wood granaries and threshed throughout the year by pounding with a mortar and pestle. Millet threshing is done by the women, as needed for cooking, and occupies about four hours daily in most families.

Peanuts are usually sold to ONCAD after harvest; most households keep a small supply in a granary or sleeping hut, to be eaten or pounded for oil.

The farmers surveyed indicated that loss of crops during storage is a major problem in Loul Sessene. Mice, rats and insects apparently eat or spoil 40 to 50% of each year's crop, despite the use of poison by some of the farmers.

Loro

Loro is a village in north central Senegal, a region of flat or very slightly rolling terrain with very little vegetation. There are apparently no wooded areas nearer to the village than forty to forty-five kilometers away, and the fields have only occasional scrub trees and small bushes.

The climate in this part of Senegal is dry relatively warm and breezy, for much of the year, with winds of 10 to 25 miles per hour. In the evenings and early mornings the temperature averages 65-70 degrees F. from October - March, and 75-80 from April to September. Most days are completely sunny, eleven hours per day, with temperatures rising to 95 degrees in winter, and in the summer, as high as 110-115 degrees. There is no rain at all for most of the year and only a few days are overcast.

Between 1000 and 5000 people live in the village of Loro, and almost all of them are farmers for about one-half of the year. As in most of Senegal, the growing season begins with the arrival of the rains, usually in late June or July, and harvesting is completed by December. The two major crops in Loro are millet, as a food crop, and peanuts, the cash crop of the country. Peanuts are sold to the local branch of ONCAD, the Senegalese national peanut cooperative; the sale price increased slightly in the past few years; it went from 4000 CFA/100 kgs. in 1978 to 4300 CFA/100 kgs, in 1979.

During the first six months of the year there is no farming activity in Loro, and there are few opportunities in the village for other gainful employment. In one of the households included in the survey sample, the head of the household makes brooms out of wood and millet stalks, for sale in local markets. In another family, a man was being paid in the first months of 1980 for construction work on a new village well. Villagers occasionally sell each other peanut hay for animal fodder, or do odd jobs for one another for a fee. Most families, however, have no secondary sources of income to supplement the money they receive from the sale of their peanut crop.

Because of the dearth of forest around Loro, the cash income or lack of income of the villagers affects fuel use patterns in the village considerably. While firewood is considered by the villagers to be the most important fuel for meeting their daily needs, it is obviously impossible for the women of Loro to travel 40 kilometers and back on foot each day to gather wood for their cooking fires. They scavenge the fields surrounding Loro for whatever brush and agricultural debris they can find; in several houses, the women spend four or five hours a day at this task. But much of the wood collecting is done in the far-off wooded areas by village men with horse or ox-drawn carts. The men then

sell the wood in Loro, occasionally by the piece but more often by a whole cartload, at around 5000 CFA per load. Two of the eight households surveyed purchase all of their firewood in this manner; three families buy wood while they have money and collect it when they have none; and three families rely exclusively on what they can collect.

Regardless of whether their wood is bought or collected, however, the wood available to the villagers is not sufficient in itself to fuel cooking fires for the five or more hours of cooking time required to prepare the steamed millet and rice diet of the villagers of Loro (two hours each for the noon and evening meals, and one hour in the morning). From January through June, the villagers use cow dung as a supplementary fuel. Dung is plentiful on the outskirts of the village in this season, as Peuhl herdsmen tend their own cattle, and those owned by other villagers, in the empty fields nearby. They carry the dung in 30 liter aluminum tubs balanced on their heads. When the rains begin, the fields are planted with peanuts and millet, and the nomadic herders take the cattle away from Loro, returning the next January. Villagers are dependent on wood purcahses during the rainy season; as the crops ripen and are harvested, the women gather agricultural debris to augment their fuel supply.

Charcoal is sold in the village for 40 CFA/kilo, or 2500 CFA/sack. According to the survey narrative, charcoal is used almost exclusively for making tea; as there is no reporting of either tea making or charcoal use in the sample households, it is difficult to determine the extent of the practice in the village as a whole. Most of the sample households prepare coffee in the morning, boiling water over a wood and dung fire; the coffee constitutes breakfast for the adults in many families, while children usually eat millet porridge, or couscous left over from the previous evening's dinner. It may be that in Loro , as in several other Sengalese villages surveyed, tea-making is reserved for entertaining or for special occasions. For heating their millet-stalk huts in the cool mornings and evenings of January and February, Loro villagers often place hot coals from their outdoor cooking fires into a clay bowl or a shallow metal pan half-filled with sand. Small pieces of wood or charcoal may be fed into these small "heaters" but there is no measured fuel use for heating purposes in the survey report. Kerosene is available both in Loro itself, and in the village nine kilometers distant, where the area's major weekly market is held. The price of a liter of kerosene rose during the survey period, from 100 CFA/liter to 120 CFA/liter. Most of the households in the village use kerosene lamps only for one or two hours in the evenings, for socializing and getting ready for bed. Kerosene use diminishes in the spring as the days grow longer, and increases in the autumn. The villagers use candles and flash-lights to supplement their kerosene lamps. Almost all the households surveyed expressed a desire for electric lighting for the village; according to the survey

narrative, they want electricity because of the status it brings, and because it is labor-saving. There is no information regarding the likelihood of electrification for Loro.

The water source for the entire village of Loro consists of two hand-dug, plastered wells (as mentioned above, a third well was under construction in early 1980). The wells are rigged with pulleys to facilitate the drawing up of water, as they are thirty-five and thirty-eight meters deep and the water level gets quite low in the late spring and early summer.

The dependence of a village of between 1000 and 5000 people on only two wells is bound to create some problems, the most apparent of which is the time it takes for the women of each compound to collect a day's supply of water. In the households surveyed, an average of 4.4 hours is spent each day in supplying the compound with water, and three of the eight families spend six hours or more.

The large size of many compounds is another factor in the length of this task; all but one compound in the sample house had more than ten people, and one of them has 41 household members. The latter household's compound uses eight 50 gallon drums for water storage, as well as numerous clay pots, called "canaris", used by the villagers to store drinking water.

In addition to providing water for their families, the women draw water for their livestock as well. While most villagers who own cows pay the nomadic Peuhl herdsmen in the area to care for their cattle, the sheep and goats belonging to the village are tended by their owners. The animals graze on peanut hay during the day, and are penned together at night. Twenty to fifty percent of the water drawn for survey sample households is for watering the livestock.

The shortage of water affected the fate of some eucalyptus trees supplied to Loro by UNICEF. Nine months after the saplings were planted, they had died for a lack of consistent watering. Further tree planting efforts are liable to meet the same fate, unless water is made more plentiful and more easily available to the villagers.

Ndankh Sene

The village of Ndankh Sene is situated 25 kilometers north of the town of Diourbel, in east central Senegal. Between 1,000 and 5,000 villagers live in Ndankh Sene year-round, and additional farm workers come to the village during the harvest season. The land around Ndankh Sene is "somewhat hilly" sandy plains with very little vegetation. There are few trees in the area, but the fields contain a fair amount of brush. During most of the year there is warm, dry weather in Ndankh Sene, with sun ten to twelve hours a day. The rainy season is July - September.

The farmers of Ndankh Sene raise peanuts as a cash crop and millet to eat or to sell at the market in Diourbel. ONCAD, the national peanut cooperative, buys the peanut crop from the farmers (all peanut farmers in Senegal belong to ONCAD) for 40 CFA per kilogram. Millet usually sells for 45 CFA/kg, but most millet raised in Ndankh Sene is stored by the farmers in their compounds in 8' - 9' high, round granaries constructed of wood and brush. Millet is the staple food of the village; most families eat steamed millet cous-cous three times a day, with a sauce made with peanuts, or, for variety, with sheep's milk.

In addition to ONCAD, which not only purchases the peanut crop but also extends credit to the farmers to buy seed peanuts and fertilizer, there is a second cooperative organization in Ndankh Sene, called Bendez. Bendez extends credit for the farmers to rent or buy machines for planting, cultivating ahd harvesting. These machines are drawn by horses or oxen and are used primarily in peanut farming, although they can also be used in preparing the ground for, and planting the millet crop.

Informally, the villagers have contributed their labor and money for repairing the four village wells, establishing a Koranic school for the religious education of boys and young men, and for establishing a garden. The government run primary and secondary schools in NDankh Sene have in the past sponsored cooperative garden projects, although there is no such project at this time.

The major market in the area is in Diourbel, twenty-five kilometers to the south of Ndankh Sene. Alternatively, the villagers can do their marketing in Ndindu, a village nine kilometers to the west. The village itself has several small shops, or "boutiques," which sell such goods as matches, soap and kerosene. Three of the eleven households in the energy survey sample own boutiques. There appears to be little problem with transportation to and from Ndindu and Diourbel; besides the two-wheeled horse and ox-carts common to Senegalese villages, Ndankh Sene has four taxis and a small truck.

The village has four wells of about 45 meters depth. From

these wells the women of the village draw all the water for their families' use. According to the survey data, this task occupies 7 or 8 hours of the women's time every day. Furthermore, the water from the wells is salty, and contains considerable sand which has fallen into the wells. There is no information given about attempts to remedy this situation.

Water for washing and bathing is stored in 200 liter barrels, while drinking water is stored in clay jars, called "canaries," which are distributed among the several houses in each compound.

Most Ndankh Sene villagers use a combination of firewood, cow-dung and agricultural debris (especially millet stalks) as cooking fuel. For an average of two hours per day, the women of each compound collect brush and fallen branches, debris and dung from a radius of about 2 kilometers around the village. Firewood is also sold in the village, for about U.S. 60¢ a bundle, although none of the households in the survey sample reported purchasing their wood in this quarter of the survey year. Likewise, charcoal is sold in Ndankh Sene for U.S. 10¢ per kilo, but as only one of the fuel measurement lists for surveyed families shows any charcoal use, it is difficult to guess the importance of this fuel to the villagers.

Kerosene is the major fuel used for lighting, although villagers also use candles and firewood occasionally for light. Most villagers used lighting for approximately three hours in the evening during the first quarter of the survey period, for eating their evening meal, studying, sewing and socializing. The price of kerosene rose from 70 CFA to 100 CFA per liter during the first three months of the year, and to 125 CFA/liter by the end of 1980. While all families surveyed expressed some dissatisfaction with their lighting, their wish was for "more lighting" in the form of electricity, rather than a concern about lighting costs. (The unanimity of these families in wanting electricity may be a reflection of a bias of the survey team, but it may be that the villagers of Ndankh Sene, living close to Diourbel and travelling back and forth so often, have some reason to expect electric service in the village in the foreseeable future. The survey report indicates that there is in fact one person in the village who has electric service, although there is no further information about this person.) In the meantime, however, the rest of the villagers buy kerosene from the village boutique, or in the town.

Crops are planted after the first rain in June or July. As mentioned above, the Bendez cooperative in the village extends credit so that the village farmers can rent or buy horse-drawn machines; there is a machine called a "hou" used to clear brush from the fields, another machine to plant the seeds, and a third machine used to harvest the peanuts. The millet crop is harvested by hand.

Most often, all the men in a household work in the fields during the growing season, with additional help from outside the village during harvesting. They apply both animal manure and commercial fertilizer to the field after the land is cleared. The seeds are then planted (seed peanuts are dusted with fungicide before planting) and weeding is done by hand or with the hou, several times per month.

After harvesting, the crops are left in the fields for 10 to 15 days. The peanut plants are then piled up and beaten with rakes to remove the nuts. Millet is not threshed in the fields, but stored as is in the compound granaries. The women of each family dehull and grind the millet by pounding it in a large wooden mortar with a heavy pestle. This pounding is done daily, for 45 minutes to an hour at a time, to prepare enough millet for the day's meals.

There appears to be ample dung in Ndankh Sene to provided both cooking fuel and fertilizer for the land. Almost all the families (95%) own at least five animals; sheep and goats are the most numerous, at 900 and 700 respectively, but the village also has 300 oxen, 300 horses and 200 donkeys. The livestock graze in the fields by day, and are tied to trees or posts at night. Most of the dung is thereby deposited on the agricultural land "automatically", although of course the women pick up some of it while collecting their firewood and millet stalks.

Horses are usally kept inside the compound, and the horse manure is piled up throughout the year and carted to the fields before planting begins.

Bakadadji

The village of Bakadadji lies about one kilometer from a small river, in the Casamance region of Senegal. The land is very flat, with a salt marsh between tne village and the river. While there are no heavily forested areas, there are many trees within five kilometers of Bakadadji to the east, north and west; the trees are widely spaced, with heavy brush and lots of bushes among them. The villagers have planted some mango, orange and papaya trees in and around the village itself. It is not a windy region, most days there is only a light breeze.

As the river and the marshes are salt water ,the village relies on wells for all water supplies. The village wells are 5 to 10 meters deep, with water all year round, except in periods of extreme drought, when the summer rains fail. The village women draw water from the wells and carry it to their compounds in buckets and basins. Many Bakadadji men have several wives; the task of collecting water is usually shared by all adult women in the family, and in those households included in the survey sample, the women spend 2 to 3 hours daily drawing the day's supply of water. The villagers complain that there is too much debris falling into the wells. Some families filter their drinking water to remove the debris, but only one family surveyed was concerned with the quality of the water itself, reporting their suspicion that their water was causing various stomach ailments.

Bakadadji is an agricultural village, with the farmers growing peanuts as a cash crop, and millet, rice and corn for their own food. The agricultural season begins with the rainy season, usually in late June, and crops are harvested in November and December. For the peanut harvest, migrant laborers from the surrounding area come to Bakadadji to work in the fields. These workers are generally paid around 200 - 250 CFA per day, and receive their meals from the farmers who hire them.

Farmers sell their peanuts to ONCAD, the national peanut cooperative, and store the millet, rice and corn in sacks, in round bamboo granaries raised on stilts, within the family's compound. As there is no farming activity in the first quarter of the year, the survey report does not detail farming practices in Bakadadji.

There is little opportunity for employment in the village during this non-farming season. Among the families surveyed, two of the heads of household are part-time fishermen, selling their catch to supplement their peanut income. One of these men explained that his fishing only provided about 5% of his income in this quarter, because the river was quite low and fish were scarce. Other ways the villagers earn money during the dry season include tailoring, construction of bamboo fencing (used throughout the village to surround compounds and areas within compounds) and

pottery making. There is a blacksmith in the village, and an agricultural extension agent resident there, and a teacher for the privately operated secondary school. Finally, a few families derive their main income from maraboutage, or religious leadership usually including instruction in the Koran, healing and counseling the Muslim members of the community.

In order to alleviate some of the money problems inherent in their one-crop, cash-poor economy, the villagers of Bakadadji have formed cooperative associations. There are two associations, each including about one-half of the village population. One of these associations is apparently inactive at present, but the second cooperative is involved in a number of projects. The group has constructed a village pharmacy and maternity center, and has organized a collective gardening project and a collective peanut field. The profits from the sale of peanuts and produce from these projects are placed into a communal account, and the association acts as a loan agency for its members, who borrow money from the account to buy food during the long dry season, as well as in the rainy season when supplies from the last year's harvest are almost gone. The loans are repaid with interest after the sale of the next year's peanut crop, and extra moneys are used to purchase medicines for the pharmacy.

The nearest market to Bakadadji is in a crossroads village six kilometers away. In this village, Bakadadji villagers can buy rice, vegetables and goods such as cooking utensils, toiletries and canned goods stocked by a "Sonadis" store, one of a chain of general goods stores throughout Senegal. A larger market is in the departmental capital, Sedhiou, 43 kilometers from Bakadadji, but this is a long trip in the two-wheeled carts drawn by oxen or mules which constitute the major means of transportation in the village.

The random sample of households in the energy survey includes a wide variety of family size, and consequently of living arrangements. The average compound within the sample houses twelve people - the range is from 2 to 20 - but even in the two-person household there are six single-room sleeping quarters, as well as 3 grain-storage structures and 3 cooking huts within the bamboo fence of the compound. As in most of the compounds, the head of the household's hut is constructed of mud-bricks, while his wife's house has walls of bamboo. In all cases, men's and women's houses are in separate areas, and often there is a bamboo fence dividing the sexes (unknown how many of the villagers are muslim - this could be purdah). Almost every sleeping house has its own fenced-in bathing area right outside. Bathing is obviously an important part of daily life in Bakadadji; more of the water collected for daily use is for bathing than for any other purpose.

All compounds have grain storage buildings, as mentioned above. Some also contain pens or "stables" for sheep and goats;

in other households the livestock is sheltered under the granaries, which are raised above the ground. Many compounds have a raised bamboo platform for sitting, napping, socializing and eating. The platforms are in the men's side of the compound. Meals are prepared in bamboo, thatch-roofed cooking huts, or on the roofed verandahs outside the rectangular mud-brick houses. In families with more than one wife, each wife usually has her own "kitchen" although this is not always the case, and in practice the multiple wives generally alternate cooking duties, with each cooking for 2 or 3 days at a time.

Whether the cooking areas are enclosed or in the open, the facilities themselves are alike, consisting of five large stones arranged to hold cooking pots over two woodfires. Villagers cook and eat three meals each day, consisting usually of a millet porridge breakfast, often with milk and sugar, and either millet or rice at noon and in the evening. The millet and/or rice is eaten with a peanut or leaf sauce, and chicken or fish is ocasionally added to the meal.

The women preparing the meals must grind millet, rice, peanuts (and corn) with a mortar and pestle before cooking. The grinding, or pounding, of the grain is a lengthy and arduous task, and one about which the women complain a great deal. There is considerable interest among the men in obtaining a diesel-powered grinding machine for the village.

The major fuel used in Bakadadji is firewood. It is seen by the villagers as the fuel most crucial to their daily needs, as it is used to cook their food, to heat their houses during the "cold" season (December, January and February), and often, to provide light in the evening. Most important of all is firewood, because it is free. Wood is not sold at all in the village; each family or household gathers the wood for its own needs. The villagers walk the areas around Bakadadji, usually finding sufficient firewood, in the form of fallen or dead tree branches, scrub trees, and bushes, within a 5 kilometer radius of the village. There are several varieties of trees growing in the region, and the preferred species for firewood is pterocarpus erinaceous, or African rosewood. During the cold months, the villagers often bring back pieces of tree trunks to burn for heat in their courtyards or bedrooms.

Contrary to the practice in some other parts of Senegal, the responsibility for collecting firewood in Bakadadji is primarily that of the men and older children, although the women of the compound gather wood if the men cannot. In the households surveyed, the men collect firewood every day, or every other day.

For lighting, the major fuel used is kerosene, which is sold in a small shop in the village at a cost of 80 CFA/liter. The price of kerosene did not rise in Bakadadji during the first three

months of 1980, although it rose substantially in other parts of Senegal. The village boutique also sells candles, which are used as a backup means of lighting, should a shortage of kerosene develop. During the long winter evenings of January and February, villagers used lighting approximately 5 hours each day. For walking around the village at night, moonlight often provides sufficient lighting; if not, the villagers rely on flashlights. In the compound of the marabout whose family is surveyed, a large wood fire is burned for light and warmth on the evenings in which the religious teacher holds his Koranic school. The village youths sit around the fire reading and reciting the Koran.

All of the animals are generally kept inside the compounds at night, with the exception of cattle, which are tethered in the fields. Cattle dung is thereby deposited on the fields, and acts as fertilizer. The village women apparently collect some of the dung in the late spring and spread it over the fields which are to be planted with rice. After the first rain of the season, the women turn the dung into the soil, before planting the rice.

According to the survey report, the soil in the fields around is quite fertile even before adding dung. There is a rich humus from the abundant vegetation, and very little sand and laterite in the soil. Use of commercial fertilizer is rare in the village. The only other information provided regarding farming practices is the fact that the villagers are very interested in finding some means of irrigating their fields.

N'Guith

The village of N'Guith is five kilometers outside of Linguere, a provincial capital in north-central Senegal. This is primarily a Wolof area, and the majority of N'Guiths's population (between 1000 and 5000 people) is of the Wolof tribe. Ten percent of the villagers are Peuhl, a cattle-herding tribe which is traditionally nomadic. (Two of the households included in the energy survey are Peuhl families, and the survey team reported that they had difficulty making accurate measurements of fuel use because these families "were rarely to be found in their compounds, always moving.")

The land in the village itself is completely flat, with some low rolling hills in the surrounding area. The lands immediately surrounding the village are used as agricultural fields from June until December, and during the other half of the year have only very sparse ground cover, growing no grass, but only a few thorn bushes and similar brush. The village compounds lie on both sides of the road to Linguere, a road lined with trees as it passes through N'Guith. There are few other trees in the countryside, only a clump here and there until, about seven or eight kilometers to the northwest, an area of forest is encountered.

This wooded area is the main source of firewood for N'Guith village, and also for other villages in the area. The combination of water scarcity, regular clearing of the fields for agriculture, and strong winds during much of the year (all but ten days of the year's first quarter had a fresh or stronger breeze and the 2nd and 3rd quarter brought gale winds of over 50 mph) has denuded much of the land in northern Senegal, and reforestation programs have met with little success. In N'Guith, the only organized effort in recent years to plant trees in the village was through the goverment program, "One Woman, One Tree." Seventy-five saplings were planted, but all died from lack of water, which is extremely scarce in the village. Unusually, there were four days in the first quarter of 1980 on which some rain fell in N'Guith, but these unseasonable rains dropped a total of 6 milimeters of water on the village, hardly enough to supprot tree planting programs.

The villagers of N'Guith are all farmers during the growing season, cultivating peanuts as a cash crop, and millet, melons and bissop (hibiscus) for food. After the harvest, many of the men of the village leave N'Guith to seek seasonal work, often going to Dakar, or even as far as Mauritania, the Gambia, or the Ivory Coast, to work as carpenters, cloth sellers and wine servants. Those men who remain in the village usually earn money by working in Linguere, or are supported by family members working there. Of the eight households described in the survey, three have members working in Dakar and sending money to N'Guith, and three have work in Linguere; one family owns a boutique in the town, one family

has five sons weaving and selling cloth, and one has a son working as a painter. The remaining two families in the survey sample are the Peuhl families mentioned above, who derive their income from raising and selling livestock and milk.

The villagers do their marketing in Linguere, travelling to and from the city by "car rapide" taxis, in the taxi or the pickup truck owned by villagers (fare is 50 CFA from N'Guith to Linguere), by horse-carts or on foot. Merchants occasionally travel to Touba or Mbacke, 150 kilometers away, to buy goods. There is a "women's center," an association of village women in N'Guith in which the 125 members pool money to buy supplies in Linguere for sewing, knitting, making pottery, etc. The finished products are then sold in Linguere, and more materials are purchased.

N'Guith has only one well to supply the entire village. The well is 73 meters deep, and water is pumped up from it by a generator which is run on diesel fuel. The pump runs the well dry in about half an hour, emptying the water into a "basang," a large cement cistern or tank. This is done twice daily, and the village women collect the water from the tank and carry it to their houses in basins balanced on their heads. As the water is already drawn up, the women spend only about one hour collecting their family's water supply for the day; one or two of the surveyed households take longer to collect and transport the water because there is only one woman available to do the job, or because water is also transported for livestock. But while the villagers do not have to pull their water up from the well with ropes, the most important fact about the well in N'Guith is that it is the sole source of water, and that , once the well is pumped dry for the morning, the amount of water available for the village is painfully obvious in its inadequacy. (According to the survey report, the larger households in N'Guith often find it necessary to bring water by horse-cart from Linguere. One of the households in the survey sample does this "when necessary.")

Firewood is the major cooking fuel used in N'Guith; although charcoal is frequently burned in small metal stoves or "furneaux," these are used almost exclusively for boiling coffee or tea. Cooking is done in a "kitchen" hut constructed either of mud-bricks or millet stalks, with a roof of grass thatch. An open wood fire is built in the center of the hut, over which a large iron pot is used to steam millet or rice with a sauce made with peanuts or vegetables. Some of the huts have two firepits, so that two fires may be built simultaneously for some meals. During the dry season, the cooking is occasionally done outside in the compound, under a canopy of thatch.

As mentioned above, trees are quite sparse in the areas immediately surrounding the village, and the main source of firewood is a place seven or eight kilometers away, where trees are more abun-

dant. Many villagers take their two-wheeled horsecarts to the wooded area and collect a large amount of firewood at one time, either for their own use or to sell in the village. Among the families surveyed, five of the eight usually buy their firewood in N'Guith, while three households regularly collect their own wood. In the households not purchasing wood, it is the men who gather the wood supply. The survey report lists the Wolof names for several varieties of wood available in the forested area, and mentions that the varieties preferred for cooking fuel are called "kel" and "seng" (grewia bicolor, and acacia raddiana, respectively).

The report also states that it is possible to find enough wood for one day by combing the immediate vicinity of the village, and this is presumably done occasionally, as needed. The major concern expressed by villagers regarding the wood supply, is that the price of wood nearly doubled during the first three months of 1980. Charcoal and kerosene prices also rose during this period but apparently not nearly to the degree that wood prices did. Unfortunately, there is not enough information provided to explain just why the prices are so high (no heating fires were reported) - only the comment of the surveyor that "you either had to pay more, or travel further en brousse to find it." Survey reports from other Senegalese villages mentioned that severe drought in the past year greatly diminished the growth of bushes and scrub trees; the lack of these alternatives to hardwood may account for some of the price rise. A charette-load of wood sold for 750 CFA at the end of the survey's first quarter; the price per kilo rose from 10 CFA to 20 CFA.

Charcoal for making tea and kerosene for domestic lighting is purchased, usually daily, in the village. Charcoal is sold by the pot, approximately 2 kilos, for 50 CFA. Kerosene sold for 125 CFA/liter in January of 1980; the price rose to 150 CFA/liter by January of 1981.

Gasoline and diesel fuel are not sold in N'Guith but are available in Linguere. There is a diesel-powered grain grinder in the village, but it is fifteen years old, and was broken most of the time covered by the energy survey. Half of the families surveyed reported using the machine to grind their millet, at a cost of 10 CFA/kilo of millet, when the grinder is operating. The other four families said that they found the grinder too expensive and preferred to grind their millet manually using the traditional large mortar and pestle. As the machine was not in operation during a good part of the survey, all the women in the survey sample used their mortars and pestles, except in one small household consisting of an elderly couple and their two small grand-children. The grandfather in this family owns a boutique in Linguere and he has the family's grain ground in the town.

The generator which runs the pump at the N'Guith village well

is powered by diesel fuel brought from Linguere. The villagers collect 500 francs each month to pay for the fuel.

Proximity to the city of Linguere may account for the fact that many of the houses in N'Guith are "urban-style" buildings of cement with roofs of tin, in contrast to the traditional mud-brick and thatch. Most of the compounds in the survey sample contain at least one cement house, and many have several cement structures. Five of the eight compounds also contain a latrine, or "wanag"; some are constructed of cement, while some consist of a hole in the ground surrounded by a fence of millet stalks.

Most of the compounds also contain millet stalk pens or thatched shelters for the family's animals. N'Guith villagers own numerous animals, including approximately 650 horses which are used for transportation, and in the planting and harvest season, for pulling a plow. Horses are almost always kept inside the compounds, whereas sheep and goats graze in the fields during the day, and may be herded into the compound or tied in the fields by night. There are about 1250 cows belonging to N'Guith villagers, although most belong to the nomadic Peuhl tribe, who represent only 10% of the village population. Other villagers usually own only one or two cows each, although they may join with several other families in constructing a millet or thorn fence corral and keep the group's cattle together in one field. Peanut hay is fed to the livestock to supplement their meager grazing.

Dung is not used in N'Guith as a fuel, but it does provide fertilizer for the soil, being raked over the agricultural fields before planting begins with the first rains of June and July. The planting of crops, weeding and harvesting is performed by the men and boys of the village, most using horse drawn seeding and plowing machines. Women may occasionally join in the weeding and harvesting, and more often join in watching over the crops left to dry in the fields before being sold (peanuts) or stored.

During the survey year (January, 1980 to January, 1981) N'Guith experienced some minor variations in the usual Sahelian weather patterns; while the normal rainy season (mid-June - early September) was late, with no rain until mid-July, there were several unseasonal rains in September and October. While these showers were usually only an hour or two in length, they fell during the harvest season, when crops were drying in the open, thereby causing some crop loss through spoilage of wet peanuts and grain.

Thiolom Fall

Thiolom Fall is a small village in north-western Senegal, 13 kilometers from the departmental capital of Kebemer. The population of the village is less than 1000 people, and all the villagers are farmers during the growing season, raising peanuts, millet and beans. After harvest, however, almost all the young men of the village as well as many older ones leave for Dakar to find work. Often, this work is "doing commerce," buying inexpensive goods and reselling them; two of the households in the survey sample derived all of their income in the first quarter of the year from the work of the household heads in Dakar. One of these men pursues "commerce" all year round, and rents out his fields in Thiolom Fall to other villagers for cultivation.

All of the land around the village is under cultivation from June to December. After harvest, the village is therefore surrounded by flat bare fields with no vegetation at all. The soil is almost entirely sand, with patches of hard sandy clay. There is virtually no topsoil on the land, and any organic matter left in the fields after harvest is blown away by the Harmattan, the hot dry wind from the Sahara which arrives in March. The Harmattan reaches its peak in April and May, tapering off during the month of June as the brief rainy season approaches. In 1980, the rain did not begin until July 9. August and September had short, hard rainstorms 2 or 3 times a week. The total rainfall was about 33 mms.

The area of Thiolom Fall is considered by villagers to be quite windy - the annual wind pattern is roughly: January & February - calm, March-June - strong winds, July-October - calm except for occasional rainstorms, November-December - strong winds. Temperatures range from 60° - 85° F. in the winter months, and 80° - 95° in the summer.

The villagers live in compounds surrounded by millet-stalk fencing. Each compound contains several buildings; many of the villagers live in extended families, with many households sharing one large enclosure, and often sharing meals and domestic tasks as well. There are two or three large shade trees in most of the compounds, under which people gather to eat, socialize and rest during the heat of the day. Where there are no large trees, shelters of thatch are erected to serve the same purpose. Shelters are also built for horses and donkeys, which are kept inside the compounds.

Six of the eight compounds in the survey sample contain at least one rectangular house built of cement or tin, usually the sleeping quarters of the household head. Round, thatch-roofed huts of millet-stalks or mud serve as sleeping huts for wives and children, and as storehouses and cooking huts. During much of the

year, however, the women cook outside in the compound, building their cooking fires on the gound between the buildings or next to windbreaks of millet-stalk or sheets of tin. (Two large households in the survey sample have over 5 rectangular houses and 4 to 8 round huts, while the smaller and poorer families have only 2 or 3 round huts altogether.)

The desertification of the land around Thiolom Fall is hastened when the rainy season does not arrive by the end of June, or when the rains are very brief (there was a serious drought in 1979). The chief consequence of drought is the increased scarcity of firewood, the major fuel used by the villagers. Ten years ago, Thiolom women could collect enough firewood for their daily cooking and other needs within one-half kilometer of the village, whereas now it is necessary to go at least three kilometers, which of course requires a great deal more time.

Villagers have adjusted to the firewood shortage by purchasing wood to add to what they can collect, by using cow dung to supplement wood in their cooking fires, and, most recently, by building fuel-conserving "Lorena" cooking stoves.

There is apparently only one family in the village of Thiolom Fall that regularly sells firewood, for which they charge 1250 CFA per horse-cart load. The wood is usually sold by cart load, although villagers occasionally buy it in bundles of about 3 kilos, for 100 CFA. Of the households surveyed, all but one purchased some of their firewood during the year. Large households buy one or more cartloads each month, others only two or three per year; in every case wood is also collected, daily or several times a week. The villagers do not want to become dependent on buying their cooking fuel. Still, the alternative of buying firewood appears to be gaining in practice, and the price is going up as well (Two years ago a cartload sold for 1000 CFA, now the price is 1250 - 1500 CFA).

Thiolom Fall is a Wolof village, and according to the survey report, "Wolofs in general do no like to use cowdung at all," but some families do now collect and burn dung in their cooking fires. The practice is not universal, and dung is clearly not a preferred fuel but it is available and free, and three of the eight households in the survey sample use it regularly during the dry season.

Wood-conserving stoves were introduced to Thiolom Fall in February, 1980, and by May there were eighteen stoves built in the village. The survey report states that "everyone wants one," because the stoves use less firewood than the traditional open fires.

The villagers use kerosene for lighting, although they say they would prefer electricity as it gives much more light. Lighting is used mainly in the evening, for socializing. During

much of the year socializing goes on outdoors in the compound, but during the dark, cool evenings of December, January and February villagers move inside their houses, which, whether built of millet stalks or of tin, have few windows and are quite dark inside.

Some families use Perrier water bottles with rag wicks, which consume a lot of kerosene; others have lamps or lanterns which are more efficient. Several of the families surveyed burn one lamp all night long, to make it easier to take the children outside during the night to relieve themselves. Kerosene is sold in the village. The price in February, 1980 was 100 CFA per liter. and in February, 1981 it had risen to 120 CFA/liter. One woman in the survey sample buys twenty liters of kerosene every two months, and sells it to her neighbors, ¼ liter at a time.

During the first months of the year, when temperatures drop to 60-65 Fahrenheit, villagers of Thiolom Fall often heat their sleeping huts in the early morning and evening. Most often, they place coals from the cooking fires into flat tin pans, and put the tin pans in the middle of the room. The villagers advised the survey team that they wanted warmer clothing rather than any different heating system, although one family mentioned their enjoyment of the sociability engendered by sitting around the fire in the mornings and evenings.

Charcoal is also used by the villagers for making tea. The charcoal is made by breaking off charred pieces of the wood from the cooking fires. There is no charcoal sold in Thiolom Fall.

There is a diesel-powered millet grinder in the village, and many families take their grain to be ground by the machine whenever they have enough money to pay 10 CFA per kilo of millet. They complain that the cost is too high, and say that they want a village-owned grinder, with which they figure they could grind their food at one-half the price of the privately owned machine. The millet must be de-hulled with a mortar and pestle before it is taken to the grinding machine. Diesel fuel is available in Kebemer, the nearest market town to Thiolom.

The only other fuel source mentioned in the survey report as widely used is batteries. Most families have at least one battery-powered radio, and several of the young people in the village also have cassette recorders which use batteries. The batteries are surely available in Kebemer, although the report does not mention their being sold in Thiolom Fall itself.

There are three wells in the village, each approximately forty meters deep. Drawing water from the wells is the responsibility of the women in each household. Most compounds have two or three large water storage barrels which the women fill from twenty-five liter pans carried to and from the wells. Some wells in the area around Thiolom Fall occasionally go dry, but the

three in the village itself have water year-round.

Villagers are not enthusiastic, however, about drawing any "extra" water for projects such as tree planting; twice, the Senegalese government gave the village saplings, which were planted but did not survive due to lack of water. The primary school teachers tried a tree-planting program at the school, but the newly-planted trees were ripped out. A few villagers do have small plantings of nime saplings near their compounds; nime is the preferred shade tree, and they will transplant the saplings inside their compounds or in another place where shade is wanted. Besides lack of water, young trees are also threatened by the sheep and goats of the villagers; these animals roam freely during the dry season, foraging for food, and they will eat the saplings if the trees are not carefully protected.

Maniora

Maniora is a small village on a river bank in the Casamance region of Senegal. The villagers of Maniora (population less than 500) are nearly all farmers during the agricultural season which begins with the advent of the rains in June. In the dry season many villagers pursue occupations such as river fishing, furniture making, masonry and tailoring; the village also has a radio repairman, and 2 cowherders who tend Maniora's 70 cows.

The land in and around Maniora is quite flat, except where the land slopes down to the river. The village is surrounded by fields which, during the agricultural season, are planted with peanuts, millet, sorghum and maize near the river's edge. Small dikes enclose several rice paddies. The fields are surrounded by forests from which the villagers gather their firewood. As in most of the Casamance region, the area around Maniora has considerably more vegetation than is found in northern Senegal; while the rainy season is as brief as in other parts of the country, there are numerous streams and rivers feeding into the Casamance river, and the water table is much nearer the ground surface. The wells in Maniora are only 3 to 4 meters deep, compared to 40 meters in the northern Sahel region of the country. There is "much brush, grass and large trees" in Maniora, including bamboo and palm trees. Furthermore, the villagers have in recent years planted numerous fruit trees, particularly banana, citrus and mango, in hope of deriving additional income.

During the first quarter of the energy survey period, (February-April, 1980) there was no rainfall in Maniora, and the temperatures varied from 70° to 110° Fahrenheit, with most days in the 80° - 100° range. The sun shone more than 12 hours a day.

Maniora villagers do not hold a market, but purchase their supplies from traveling vendors who pass through the area. The nearest market of any size is 65 km away. The only fuel sold in the village, kerosene, is usually purchased in large quantities by the village chief, who sells small amounts to villagers to use for lighting their homes. In the last quarter of the survey period, most villagers bought kerosene from a village 3 kms away.

The village has formed several community organizations for economic and social activities. The household heads pay a yearly membership fee to a credit cooperative, from which they can then borrow money at low interest. The coop has 40 members, virtually all of the household heads in Maniora.

The women of the village have formed two organizations, with membership along tribal lines. The Diola group has 28 members, the Mandimba group, 15. Each of these organizations cultivates a vegetable garden every year, and they also have a credit operation

funded by sale of produce from the gardens. A fourth organization in Maniora is a youth group, which raises money for buying soccer-balls, throwing parties, etc., through monthly donations from members and through hiring the group out to do work, such as clearing land for the womens' garden projects.

Other than this sort of casual labor, there is little opportunity for paid employment in Maniora. After the peanut harvest the crop is sold to ONCAD, the national peanut cooperative, for .43 to .52 CFA/kilo. Thus during January and February, the villagers usually have a quantity of money, and several Maniora families travel out of the village during this time. Others take to their dugout canoes and fish the river with handmade nets, selling fish to their neighbors in Maniora and to nearby villagers. Some people work on clearing new fields for cultivation. Of the ten families in the survey sample, seven reported augmenting their agricultural income, through tailoring, furnitutre making, selling shrimp and fish, radio repair, masonry and repairing thatch roofs.

Houses in Maniora are constructed of mudbrick, with roofs of tin or grass thatch. Some of the households in the survey sample are located in compounds consisting of several 2 or 3 room mud-brick houses, with separate thatched huts for cooking. Several others have large houses with four to eight rooms and wide roofed verandahs at front and back. Four of the 10 families in the survey sample live in these large houses which they share with another family; in this arrangement each family generally occupies one side of the house and uses one verandah, either the front or back, for socializing, cooking and eating. As is usual in Senegal, much of the villagers' time is spent out of doors. Most houses have at least one large shade tree nearby, where the household and guests can sit in comfort. Wide, shaded verandahs serve the same purpose.

Five of the households in the survey sample have a separate thatch-roofed cookhouse next to the sleeping house, while the remaining five families cook on a part of their verandahs, usually screened from the wind with bamboo mats. Food is prepared over a woodfire, with pots resting on three large stones around the fire. The women in each household are responsible for cooking the meals; in households with more than one wife or with several adult women, cooking chores are often alternated, each woman taking responsibility for one or two days at a time, or for one meal a day. The women in the sample households report spending two to three hours in preparing each of three daily meals. Many families in Maniora eat cornmeal porridge in the morning, served with sour milk and sugar. Noon and evening meals are usually millet, sorghum or rice, with a sauce of vegetables flavored with peanuts or fish. In the spring, villagers make a sauce using a kind of palm fruit which ripens only at this time of year. Mangoes and bananas also make up a part of the diet when available. Meals are often eaten outside in the compound or on the verandah, if the day is warm; in

many homes the men eat apart from the women and children of the compound.

Fuel for the cooking fires is collected by Maniora women from the wooded areas beyond the agricultural fields. In most households the women go foraging for wood two to four times a week, for several hours at a time. They cut large amounts of brush and gather fallen branches from the numerous varieties of hardwood trees of the region. Occasionally, women in households which own an ox-cart or donkey-cart will pile up huge stacks of wood for the men of the compound to collect by cart. The villagers did not express concern about the availability of firewood in the first half of the survey year, although several mentioned to the survey team the fact that it took longer to find a two or three day supply now than it did two years ago. By the second half of the survey period people were more concerned about the firewood supply, although wood was certainly available; in the rainy season and during harvest time in the autumn, dry fuel is scarce. In addition many women assist in the harvesting and drying of crops, and thus have less time to spend collecting firewood.

Charcoal is apparently sold in Maniora, although no charcoal use was recorded in the households of the survey sample. One family surveyed mentioned having a small metal charcoal burner which they use occasionally (in winter) to heat a bedroom in the house; the survey fuel measurement records do not show charcoal purchases for this household, and it may be that the charcoal used for heating is taken from the cooking fires as is a common practice in other Senegal villagers. The survey team reports that for most families, the only heating comes from bonfires in the compound, using "enormous" logs hauled in by cart, and corn cobs.

For domestic lighting, the Maniora villagers burn kerosene in small lamps and lanterns. The kerosene is usually purchased in small amounts as needed from the village chief or from a nearby village. Most families in the sample use only one or two kerosene lamps, to provide light in sleeping huts or bedrooms for preparing for bed and for nightlights for the children. In winter when days are short and evenings cool, more families move from the "sitting places" in the compound to their verandahs or inside to eat the evening meal; for this reason, more kerosene is used at this time of year. One family made several new lamps from coffee cans for more lighting in February, 1980. Many households also have flashlights, which they use for moving around the compound or the village at night. The price of kerosene in Maniora rose from 95 CFA/liter in February, 1980 to 110 CFA/liter one year later.

Firewood, kerosene and charcoal are the only fuels used regularly in Maniora. According to the survey report, gasoline and diesel fuel are available in a village 10 kilometers away (although the gasoline station was closed in August and September). There appears to be little demand for these fuels in

Maniora, however, except for a couple of people who drive mopeds. A son in one family in the survey sample works as a taxi-driver, but this presumably is in another location, as the report states that there are no taxis or trades based in Maniora. For transportation to other villages, residents use ox and donkey carts and bicycles (25% of the households own bicycles).

The women of the village expressed a strong desire for a grinding machine to relieve them of the time-consuming, exhausting daily chore of pounding and grinding of grains. It usually takes the women three to four hours everyday to prepare millet, corn, rice and cassava by pounding it in large wooden mortars. They are aware that several other villages in the area have acquired grain grinders powered by diesel fuel, and feel that it would be beneficial to have such a machine in Maniora, despite the fact that diesel fuel prices have risen throughout the year.

There are seven wells scattered throughout this small village, and these wells provide all of the drinking water for the villages. The women carry water from the wells to their compounds in buckets and basins balanced on their heads. Most of the compounds in the survey sample are no further than 50 meters from a well; even so, the task of carrying water usually takes one to two hours daily. Within the houses or cooking huts, the water is poured through a cloth to remove debris, and stored in large clay jars which keep the water cool through evaporation through the unglazed walls of the jar.

The village wells are about 3 or 4 meters deep, and provide water year-round. The river flowing beside the village was once the major source of water, but has grown increasingly salty over the past several years. The village well nearest to the river has now begun to turn salty, as well.

Farming practices in Maniora are similar to those in other parts of the country. The fields are cleared of brush and grass during the spring months, with the large brush and branches hauled to the compound for cooking fuel during the rainy season. Crops are planted as soon as the rains begin (usually June); the land is first prepared with a plow drawn by oxen. These plows are relatively new, having been introduced to Maniora within the last ten years. Corn is usually planted first, then peanuts, millet and sorghum. Some of the farmers get commercial fertilizer on credit from the national peanut cooperative, ONCAD, with the cost of the fertilizer, plus interest, deducted from the money they receive from ONCAD for the sale of their peanut crop. Animal dung is also used for fertilizer; the women collect it for field crops from the area outside the village where the cattle are tended.

In most households, the planting, weeding and harvesting is a family affair, with everyone eight years old or over working the fields. An exception to this rule is rice farming, which is

generally done by the women. Rice seedlings are started in seedbeds inside the compounds. Then the women prepare small fields in or near the river bed, turning over 1-3 inches of soil with hoes, spreading dung from the cattle and sheep, and building small dikes of earth to hold water in the field. In July, after the rains have started and the level of the river begins to rise, the seedlings are transplanted into the rice fields, and water is held as long as possible by the dikes. The wetland rice fields are not weeded. The women harvest the rice with knives, tying it into small bundles and placing it on the roofs of their houses to dry in the sun.

Corn and millet are also sun-dried on roofs or raised platforms, while peanuts are usually dug up and raked into piles which are left in the fields to dry. The dried peanut plants are hit with rakes and poles to shake off the nuts, which are sold to ONCAD without further storage. Grains for family consumption are only partially threshed before storage; most are stored "on the head (or cob)" and threshed by pounding with mortar and pestle for cooking. Grains are stored in raised granaries made of woven bamboo with thatched roofs. Rodents and insects cause some crop loss; most granaries are raised 3-5 feet above the ground, on stilts, which provides some protection from the pests. Occasional rains during the drying period (2 weeks to a month) cause additional spoilage of grains.

One of the farmers interviewed by the survey team spends the dry season as a fisherman. He takes his dugout canoe out on the river two or three times a week often accompanied by one or two of his sons. The sons paddle the canoe while their father stands in the boat and casts his net. The net is drawn in immediately, emptied, and cast again. Any fish not eaten immediately are dried on the house roof and stored in burlap bags in the cooking hut.

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